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Modern School Houses

Being a Series of Authoritative Articles on Planning, Sanitation, Heating and Ventilation

By

A. D. F. Hamlin, Professor of Architecture, Columbia University; C. B. J. Snyder, Architect to the Board of Education, New York; William B. Ittner, Architect to the Board of Education, St. Louis, Mo.; Frank Irving Cooper, Architect; William H. Brainerd, Architect; Charles Morris, Architect; Frank G McCann, Chief of Heating and Ventilating Division. Board of Education, New York; Charles F. Eveleth. Heating and Ventilating Engineer, School House Department, City of Boston; Leo H. Pleins, Sanitary Engineer, and others

To which is added more than 145 pages of illustrations of recently constructed School Houses, from the four-room buildings to the Normal and Technical Schools, together with plans, working drawings and descriptions, many of which have not heretofore been published

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MODERN SCHOOL HOUSES

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Preface

WHEN that celebrated literary personality of the eighteenth century described architecture as frozen music, she gave a most happy expression to an artistic conception of the building art. Regarded from another of its many sides, architecture to us of later generations is, perhaps, better understood as the crystallization of civilizations. The buildings of a people reflect faithfully the dominant tendencies of its ideals and pursuits. The story of civilizations is, therefore, accurately told by its imperishable constructional remains. Egypt was a land of the tomb with its enshrouding mystery; Greece recalls the zenith of physical and intellectual perfection; Rome the splendor of war and wealth; and medieval times the ascendency of religion; while modern times typify the fruits of scientific discovery and invention.

The development of building has kept pace with the growing complexity of civilization, and nowhere is this more noticeable than the field of education. If the simplicity of the Greek teacher is pictured with his pupils on the steps of the Temple and compared with the intricacy of the modern curriculum in the highly organized building the smallest detail of which is designed for the purpose, an idea is gained of the extent and nature of the evolution.

In the selection of school houses gathered together in this volume will be found a fair representation of the most recent developments in their planning, architectural handling and mechanical equipment. The articles likewise have been chosen to cover the subject in the broadest manner and without unduly accenting any one type, material, process or device over another that may possess equal merit for other conditions. If the labor of making such a book as this is rewarded by the greater interest of architects and others in the problem of housing our educational institutions in the best adaptable buildings and surroundings for intellectual, physical and moral welfare, its existence is justified. By a comparison of the public-school accommodations of our large cities twelve or fifteen years ago with those of to-day, it will be noted how complete a revolution has been wrought. There remains much to be done, however, in bringing the general average of our school houses up to the high level of our best performances; the architect in good standing has not yet come into his own. Another purpose of a book of this kind is to make him the most important factor in the community desiring to build a school.

MODERN SCHOOL HOUSES

FIG. 5, DOLLY WHITNEY ADAMS MEMORIAL SCHOOL, ASHBURNHAM, MASS. MESSRS. COOPER & BAILEY, ARCHITECTS

THE PLANNING OF SCHOOL HOUSES

BY FRANK IRVING COOPER

EVERY architect entrusted with the planning of a school building is confronted with the problem of satisfying the citizens in regard to the appearance of the building, of satisfying them that it shall meet the needs of the educators, and that it shall be so permanently and sanely constructed that its maintenance will not be a burden to the taxpayer.

These results are difficult to secure, far more difficult, too, when the architect is selected by competition. The architect should be chosen even before the site is decided upon, as frequently the site chosen makes a satisfactory building almost impossible.

The determining factors in the size and style of the school building are the site, the appropriation, and the number and grade of the pupils to be accommodated. Knowing these, the architect is prepared to lay out plans for any particular building.

The direction from which the pupils come, the number of pupils to be accommodated, and the position of the playground determine the entrances of the building.

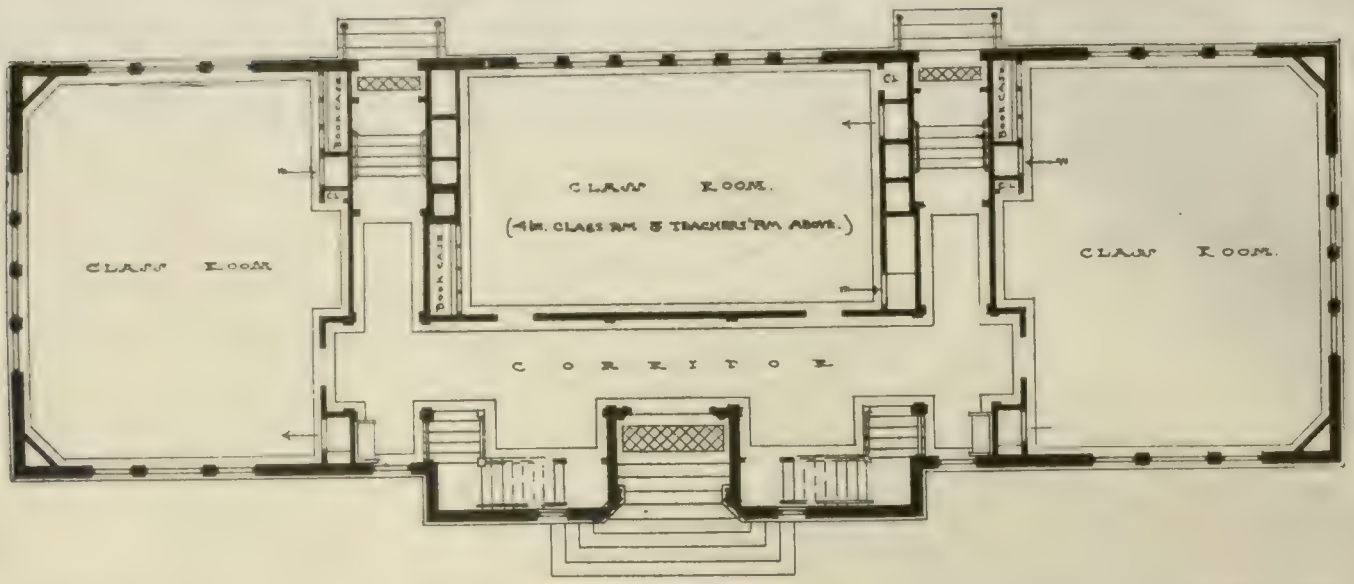
The size of the building and the entrances having been determined, the character and layout of the building further depend upon whether it is to be extended or compact.

A compact building is one in which the building and its parts occupies the minimum amount of space. (See illustration No. 2.) When the grounds and the available funds allow more ample proportions the plan of the building may be extended. (See illustration No. 4.)

The skeleton of each building consists of its main halls and corridors. There are three types of corridors

The straight line corridor is the simplest type. Illustration No. 2, Woodbridge School, Newbury, Mass., and illustration No. 4, the Ames School, South Easton, Mass., show schools based on this type of corridor.

The ell (L) corridor is the next type. Fig. 6, the Dolly Whitney Adams School, Ashburnham, Mass., represents school houses having this type of corridor.



FLOOR PLAN FIG. 6 DOLLY WHITNEY ADAMS MEMORIAL SCHOOL

The T corridor is shown in illustration No. 8, the Colt Memorial High School, at Bristol, R. I.

All schemes for corridors may be resolved into one of these three types.

Whenever possible it is best to use the simplest form, even a modification of this form is better than a more complex form.

Illustration No. 10, the Malden High School, Malden, Mass., shows an extended building in which a modified form of the T corridor has been used.

When the skeleton has been decided upon, the arrangement of the rooms is settled to a certain extent, the positions of the stairways are determined with consideration for safety in case of fire, convenience in going from floor to floor, and comparative value of floor space.

If there are to be large or especially important rooms such as assembly hall, gymnasium, large study room, laboratories, lecture rooms, drawing rooms, manual training rooms, boiler room or sanitaries, they should receive the architect's next attention, and any special condition in regard to any of them must be considered.

Then follows the distribution of the general rooms, class and recitation rooms, wardrobes, library and store rooms.

WOODBRIDGE SCHOOL, NEWBURY, MASS. FIG. I MESSRS. COOPER & BAILEY, ARCHITECTS

All rooms to be used for school purposes must be supplied with adequate natural light; no pupil should be seated more than twenty feet from the source of light. There are two good methods for introducing natural light, a long, narrow room may have sufficient window surface on a long side, or a broader room may have window surface on two sides. Light should come over the left shoulder of each pupil.

The system by which the building is to be heated and ventilated is practically settled by the appropriation, and the size and arrangement of the building.

The laws of some States lay out the system and determine the results to be obtained. In all cases a modern system which will secure proper results should be employed. The simple systems are entirely adequate when the buildings are small and compact.

Abundant quantities of warmed fresh air should be introduced through ducts to each schoolroom, and care must be taken that the ducts are of sufficient area and directness for passing the required amount. Ducts should also be provided for removing the vitiated air.

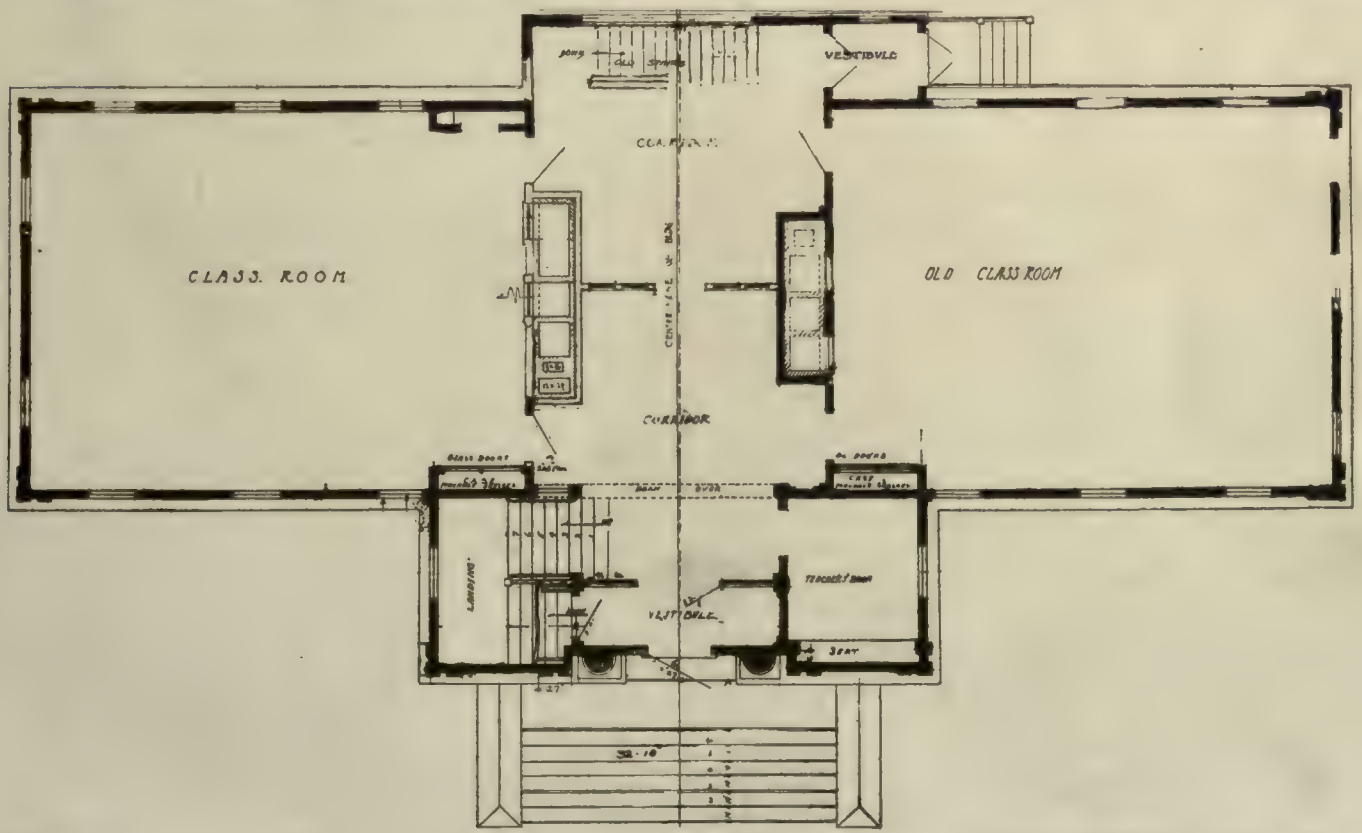
All modern school buildings should have a system of telephones, electric clocks and signals as aids to administration.

An architect who intends that his school buildings shall be successful must constantly keep in mind the requirements of the teachers and pupils who are to use the building; he must remember that it must be so constructed as to safeguard their lives against fire or panic; that the sanitary constructions should be those which will prevent disease; and that the final cost of the building should never exceed the amount placed at the architect's disposal.

CONSIDERATION IN SCHOOL HOUSE DESIGN. BY A. D. F. HAMLIN, PROFESSOR OF ARCHITECTURE, COLUMBIA UNIVERSITY.

The data for the designing of public school buildings have been more completely standardized than for any other type of structure, except the American public library. The public school concerns more intimately and directly a larger number of persons than any other class of public edifices, and since its design may affect for better or for worse not only the educational work and administration of the school but the health and happiness and even the morals of the pupils, the principles which should control its design have been made the subject of special study for many years past by the health authorities, as well as by the educational boards of all the more highly civilized countries and communities. In most States and cities the conclusions of the experts in sanitation and in school administration have been embodied in legislative acts and municipal building codes; and while these vary widely in the minuteness of their specifications and the severity of their restrictions, they are generally in substantial agreement as to certain fundamentals which have become commonplaces of principle among school experts of all classes, while the more detailed and minute of these codes represent the most advanced teachings alike of the sanitarians and the educators.

This careful formulation of the data of school design taken in connection with the general uniformity of types and requirements for buildings of any one category, makes the problem of school design comparatively easy for the architect, so far as general plan and form are



FLOOR PLAN FIG. 2 WOODBRIDGE SCHOOL, NEWBURY, MASS.

AMES SCHOOL, SOUTH EASTON, MASS. FIG. 3 MESSRS. COOPER & BAILEY, ARCHITECTS

concerned. By so much the more, however, does this give him the opportunity, and thereby impose upon him the duty, of devoting abundant time and careful study to the details and execution of the design, which is all the more imperative when one reflects how large a span of the life of a community is spent within the walls of its schools, and how important it is to surround its children with the most perfect environment for their hours of study. The schoolhouses of any community are gauges of its enlightenment. They should be the best and most carefully constructed buildings it possesses: not the most splendid and ornate, but the most perfect in design and complete and thorough in execution and equipment. This is, as anyone may see for himself, very far from being generally the case, and wherever a school building falls short of this high standard of excellence, some one—or the whole community—has blundered. Such falling short may be due to the ignorance or incompetence of the architect, or to the ignorance and incompetence of the School Board, or to an inefficient city or county government, or to the parsimony and shortsightedness of the community itself; but all these causes are phases of blundering, private or public. It is rare indeed that the inferiority of the school architecture of a town or country is due to deliberate fault and corruption. Even where corrupt officials have made the school buildings the prey of their political or financial cupidity, they have done so only because the public and the educators have been careless or stupid, in other words have blundered in their control of their own affairs. As a general rule the people mean to be generous to their schools, and it requires only the diffusion among them of correct information on the subject to secure from them all that is necessary for the erection of suitable and creditable school edifices. In this work of education the architects can and should rightly take a prominent part, and if they will always and everywhere stand for the highest excellence in all that pertains to school architecture, the national reproach of our backwardness in this branch of design will before long be wholly wiped out. It ought to be said that the last fifteen years have witnessed a great advance in the average quality of American school buildings, and that in the larger cities, and notably in Boston, New York, Chicago and St. Louis, a very high standard of design and construction has been set and maintained by such men as E. M. Wheelwright, C. B. J. Snyder, Dwight Heald Perkins and W. B. Ittner, respectively, and in many other cities by conscientious architects less widely known only because they have had less conspicuous and extensive opportunities.

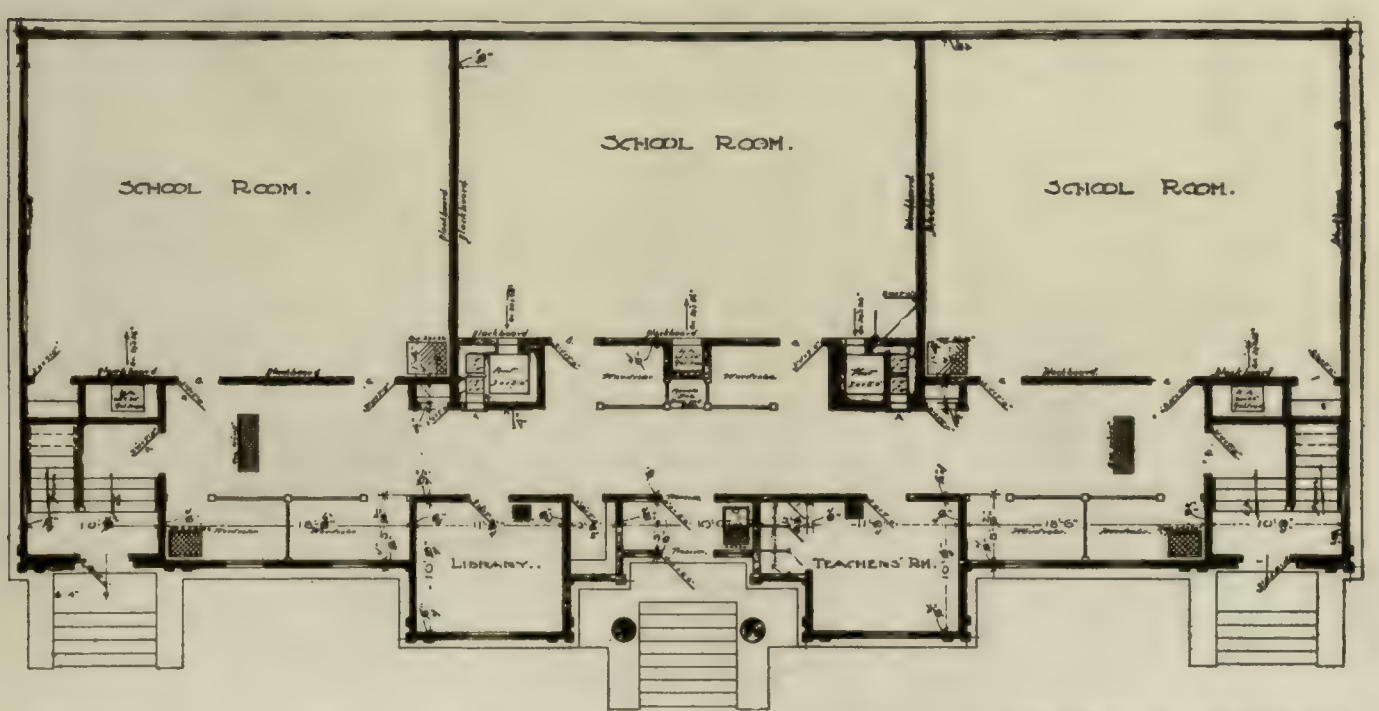
The chief elements of the schoolhouse problem may be divided into those relating to planning, to equipment, and to construction. The controlling elements of the plan are the classrooms and the communications. These are fundamental and universal; all else is in a way subsidiary to them. Assembly halls, laboratories and studios, cloakrooms and toilets, gymnasiums and baths, teachers' rooms, offices and reception rooms, libraries and cabinets and lunchrooms, subserve in various ways the work done in the classrooms. Many of these may be wholly wanting; only the larger high schools contain them all. The communications comprise entrances, corridors, halls, stairs and elevators. The chief elements in the equipment are, first the apparatus or plant for heating, ventilating and lighting the building, then the furniture of the various rooms and departments, and finally the sanitary arrangements—lavatories, baths, lockers and plumbing. On the side of construction the chief elements of the problem relate to materials, especially to

the question of the exclusive or partial use of fireproof or noncombustible materials.

On all these elements of the problem more or less positive opinions have been pronounced by competent technical authorities, both in Europe and America. In reaching these conclusions there has been general co-operation between the educators and the medical men, and on all the fundamental questions involved there is substantial unanimity. As to details there is wide divergence, and practice varies widely, not only as between European and American schools, but in Europe itself, and still more widely in America. The differences are, however, greater in seeming than in reality, and are chiefly due to different educational systems and methods. The variation is greatest in the United States because we have no central or imperial authority stamping its informal seal upon all our schools. While our own democratic principle of local self-government lends itself sometimes to local inefficiency, it stimulates initiative, and gives larger scope for the working out of new or special problems. The very first thing, therefore, which the young architect needs to do in handling a schoolhouse problem, is to familiarize himself with the schools themselves; with the educational system and organization of the place, its methods and its aims, and with the details of the work of the schools, particularly of the grades for which the new building is required. Thus the question of cloakrooms must depend upon the regulations in force for the arrival and departure of the pupils; and an assembly room, which is used but once a week or once a month, may be tolerated on an upper floor, to which it would be unkind and disturbing to require the pupils to climb twice a day. In some schools the pupils remain in their classrooms while the teachers rotate from one to another room and division; in others the pupils pass from room to room at each recitation period. Some schools provide gymnasiums, lockers and baths, under constant supervision from basement attendants, others have none. A boys' high school must be differently planned from a mixed high school, and so on.

I propose to sum up very briefly some of the leading points on which the best modern American practice has reached fair uniformity; and then to note some of the problems which still await final solution. No doubt much of what follows will be absolutely commonplace to many of my readers, but it may be helpful at least to some of the younger practitioners, as well as to educators and laymen who have to do with school buildings, their planning and construction.

Classrooms. The classroom is the fundamental unit of the schoolhouse design. In American practice it is distinguished on the one hand from the recitation room, which has only chairs or settees for the pupils and is used, as its name implies, only for recitations (or sometimes also for lectures and dictation exercises); and on the other from the general study room, which is found more frequently in Europe than with us, and in which a number of classes, aggregating a hundred or two of pupils, spend the assigned hours of study between recitations. The normal American classroom accommodates from 30 to 50 (or rarely up to 60) pupils at fixed desks. In some special or private schools the number in a classroom is as low as 25; but economy of administration makes it desirable that the number should not fall below 30 to 35, while efficiency demands that it should not greatly or often exceed 40. Each pupil has a desk, and the total floor area should not be less than 18 square feet per pupil, with at least 216 cubic feet as the minimum cubic volume per pupil. Twenty square feet and 260 feet, respectively, are better figures for all except the lower grades attended by small children. A slightly oblong room, with the teacher's desk at one end, is the best shape. Thus for a 40-desk classroom in an upper-grade grammar school or high school, a room 32 by 25 feet, 13 or 14 feet high in the clear,



FLOOR PLAN — FIG. 4 — AMES SCHOOL, SOUTH EASTON, MASS.

COLT MEMORIAL HIGH SCHOOL, BRISTOL, R. I. FIG. 7 MESSRS. COOPER & BAILEY, ARCHITECTS

would represent excellent practice. One ample door, 40 to 44 inches wide, should be provided near the teacher's end of the room, alike for entrance and exit. Such a door is wide enough to allow two files to pass in or out at once, and is under the teacher's eye and full control. A wide aisle, 3½ to 5 feet wide, should skirt the room next the corridor-wall, and a narrower aisle next the window-wall and the rear end of the room. Six rows of seven desks each from front to rear can be conveniently placed in a room of the above dimensions. More than seven or eight desks in a row place the rearmost pupils too far from the teacher and the blackboard, so that the length is best not much over 32 to 36 feet; and it is undesirable, as we shall see later, to make the classroom more than 25 feet wide. Widths of from 27 to 30 feet are common in the United States, but do not represent the ideal practice.

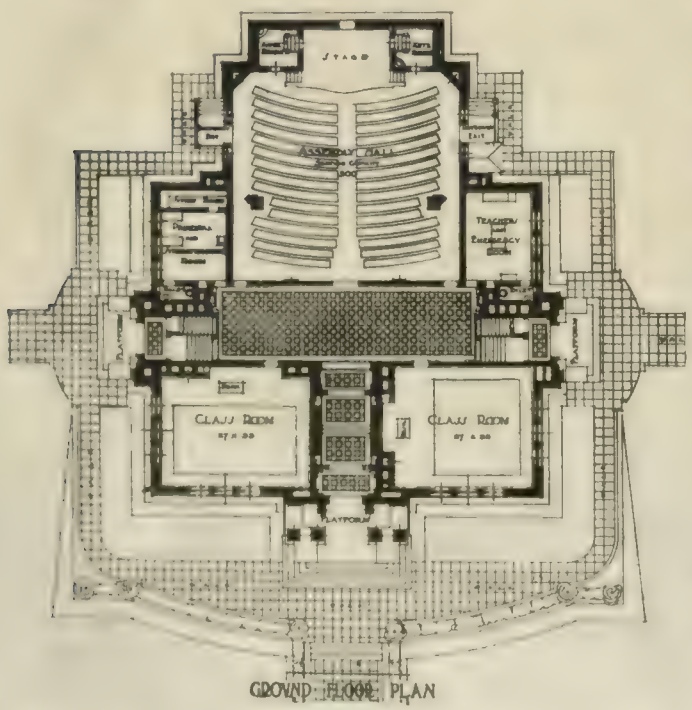


FIG. 9. PLAN COLT MEMORIAL SCHOOL, BRISTOL, R. I.

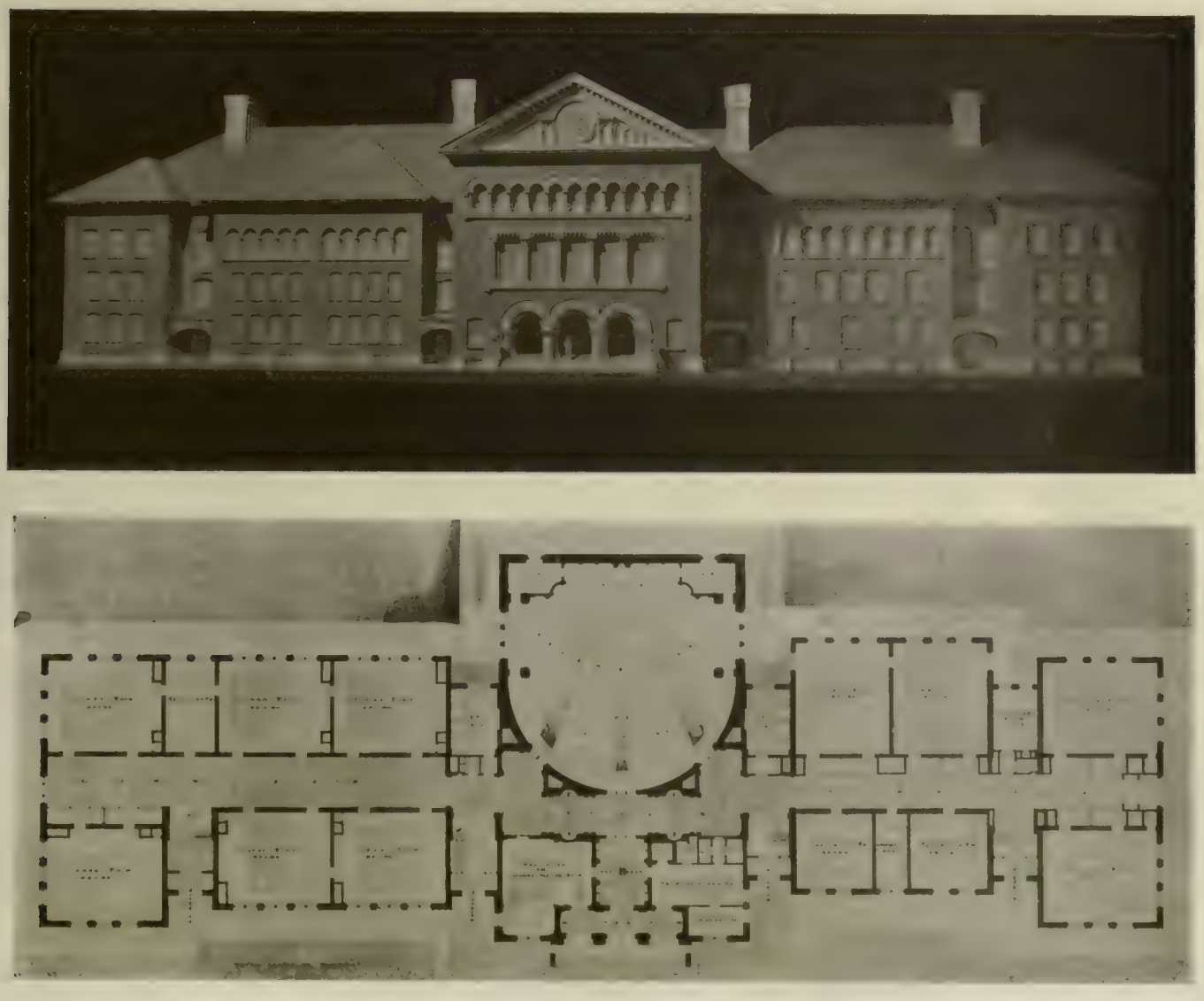
COMMUNICATIONS. It is customary in our larger school buildings and in all buildings for mixed schools, to provide at least three entrances. One for the public, and one each for the two sexes. The location and designing of these do not always receive the study they demand, with reference to the convenience and comfort of those who are to use them, as well as to their easy supervision. Outside and unsheltered steps should be avoided as far as possible, as being dangerous and troublesome in icy and inclement weather. Whether the pupils should enter the basement and then go up, or enter the main floor and thence go down, or enter by a "split level" door, going either up or down a half-story as may be required, depends partly on topographical conditions and partly on the custom and administration of the school. A very common mistake is the failure to provide at each entrance a suitable lobby, with inner doors, so as to interpose two sets of doors between the interior of the building and the outer air. When this blunder occurs, the hideous excrescence of storm doors becomes a necessary corrective during the winter months.

Main corridors should be never less than 8 feet wide, and in the larger buildings 10 feet should be the minimum width. It is, however, wasteful to make them

more than 12 to 14 feet wide, except at points near the heads or feet of stairways, or at entrances or exits, and other points of probable congestion, where the width should be suitably expanded. Minor corridors may be 6 or 8 feet wide. It goes without saying that corridors should be as straight and well-lighted as possible.

The stairways should be never less than two in number, complete from top to bottom of the building, and should always be sufficient to empty the school in three minutes. They should be so placed as to be within the shortest possible reach of the largest number of classrooms; for example, so that no classroom door shall be more than (say) 40 feet distant from a flight. They should, moreover, be located at conspicuous points in the plan, where their position is clearly announced by the architectural features of the interior. Their width should be such as to allow two files of pupils to ascend or descend, with sufficient intervening space to permit of the passage of one or more persons between them. A width of 4½ feet per run, which is found in many schoolhouses, is insufficient for this; 5 feet is the minimum, and 5½ feet is better. Six feet is the maximum width allowable; any greater width than this is wasteful. There should always be two runs and a single wide landing between each floor and the next; never three runs with two landings, if it can possibly be avoided; and never a single straight run from one story to the next. The two runs should be in reverse directions. There should, therefore, be no open well between the runs. It is sometimes recommended to divide the staircases from the corridors by wire-glass partitions and safety-doors, but this is, in my judgment, a precaution of doubtful utility, if not actually a source of possible danger. The stairs should, of course, be well lighted by windows.

Assembly Halls. Not all public schools require these, and where they are required, specially in high schools, they serve very varied functions in different places. They are usually planned to accommodate considerably more than the maximum number of enrolled pupils, and are often in demand for meetings or entertainments outside of the school program. Allow 6½ to 7 square feet per seat for the total area of the floor exclusive of stage or platform, but including aisles, and arrange these so that the center of no seat is further than 11 feet from an aisle.



ELEVATION AND PLAN, MALDEN HIGH SCHOOL, MALDEN FIGS. 9 AND 10 MESSRS. COOPER & BAILEY, ARCHITECTS

The Assembly Hall should have natural light from one or both sides, in addition to overhead lighting, if any; but there should be no windows facing either audience or speakers, especially the former.

The Assembly Hall is best placed on the ground floor or on the first main floor. It is highly undesirable to place it on the third or top floor, as is sometimes done; not merely because of the additional danger from fire or panic (and panic has cost more lives than the flame itself, in schools and places of assembly), but because of the increase of otherwise unnecessary stair climbing that results. From this point of view the second floor is the most convenient, as being midway in height; but if general exercises are held daily at the opening or closing of the session, the first floor or ground floor is still more convenient because of its nearness to the level of the entrance and exit of the school. The hall should have ample doorways and plenty of them, and these be arranged for most convenient access to and from the stairs.

Other Rooms.—No rules can be laid down for the arrangement of the other rooms required, such as lunch-rooms, laboratories, studios, manual-training rooms, teachers' and reception rooms, and the like, as each school building presents in respect to these a new problem, and the size, position and arrangement of each must be determined with reference to particular conditions and requirements. The more particular and special the use and requirements of a given room, the more important is it for the architect to acquaint himself with those who are to use it or who have had experience in the use of such rooms, to seek for suggestions from them, and to endeavor to meet their views and experience as far as possible.

Sanitary Provisions.—These relate to light, heat and ventilation, and to the plumbing installation, gymnasium and baths.

Lighting.—It is universally agreed that classrooms should be lighted from one side only, unless of exceptional width. A partial exception is sometimes made for corner rooms, which may have windows in the end at the rear of the desks, opposite the teacher's platform. The best practice, however, discountenances this and favors a blank wall opposite the teacher, so as to avoid the glare in his or her eyes from windows behind the pupils. Moreover the pupils in the two or three rear-most rows sit in their own light from such windows, which is unpleasant and often injurious to sensitive eyes. The best light for a classroom is that which comes from the left side and from slightly in front of the pupil. Light from "over the left shoulder" is often advised as the best for reading; but it is bad for writing and drawing, as it casts the shadow of the body across the work on the desk. The total window area should equal from 40 to 50 per cent. of the total wall area of the long side of the room, and in general, one-quarter the floor area of the classroom. The windows should extend up to within 6 inches of the ceiling; the window stools should be from 3 to 3½ feet from the floor. Light from below that level is useless; it is the height of the top of the window that determines its lighting efficiency. The sill should, however, not be higher than 3½ feet from the floor, as it is desirable that the pupils should be able to rest their eyes at times by looking out at more or less distant objects, which is impossible for many with a sill 4½ or even 4 feet high. It is considered good practice in this country to allow double the height of the window-head for the width of the class-room. This gives 25 feet of width for a ceiling-height of 13 feet, the window-head being 12½ feet from the floor. Increasing the horizontal dimensions of the windows only partially makes up for lack of height, and with a 13-foot ceiling a class-room should not exceed 25 feet in width; or if wider than this, it should have only as many desks as a 25-foot room, and the excess of width be wholly put into the broad aisle next the corridor wall. The French rule is much more severe, the official standard requiring the width to be limited to one and a half times the height of the room. This rule might well be applied to city schools on narrow streets or sites opposite tall buildings; otherwise for conditions in any part of the United States the French requirement is too narrow. If end windows are required in corner classrooms, they should be set far apart, so as to present a broad wall surface directly opposite the teacher instead of the glare of windows. Classroom windows may be arranged, if desired, with hinged transoms, but in that case the transom bars should be of wood or metal, relatively narrow, and never of stone or terra-cotta. Massive architectural transom bars cast unpleasant shadows and impede much light. Whether the windows should be massed with narrow mullions, as in a studio, or evenly distributed is a matter of some controversy. The question is probably not of great importance, though the general tendency is toward massing or grouping them. Studios require a north light, and are best placed in the roof story where the sash can be extended up into the skylight. Manual training-rooms should be well lighted, and it is a mistake to place them in a mezzanine or low basement, because a nearly horizontal light is very trying on a work bench. They require high-level lighting as much as do the classrooms.

Corridors should receive natural light and ventilation from outside windows. A long corridor lighted wholly by borrowed light, no matter how abundant, invariably produces an effect of confinement which is depressing. Windows on stair-landings are very serviceable, as they shed their light far into the corridors. Windows at the end of corridors are better than none, and interior courts, if open to the sky and still more if inclosed only on three sides, serve admirably for the lighting and airing of corridors. There is, of course, no objection to borrowed light as an accessory to direct window-lighting; but it must be remembered that glass transoms and glazed doors, though they afford light, give no air to the corridors, and cannot take the place of windows opening to the outer air.

Skylighting is all that is needed for picture galleries, but it does not suffice for assembly halls, or even gymnasiums, since it fades early in the afternoon, does not permit of the entrance of sunlight, and affords very scanty, if any, natural ventilation. Windows on either side of such a hall admit the sunshine and permit of a complete freshening of the air both before and after every gathering in the hall.

Ventilation. The importance of adequate artificial

ventilation cannot be exaggerated, and modern schoolhouses are, as a rule, much better equipped in this respect than was formerly thought necessary. But it must be remembered that thorough artificial ventilation is always an expensive luxury, both in first cost and in operation and maintenance. Moreover, it is in practice inseparably connected with the problem of heating, although the two functions are in theory wholly distinct and independent. While the fundamental principles are simple enough, their application involves many technical complications, and for any considerable building a competent and independent consulting engineer should be engaged to plan or to assist in planning the heating and ventilating installation. Unfortunately a considerable proportion of the professional heating and ventilating engineers are directly interested in the particular systems of particular companies manufacturing various types of apparatus. The young architect should, therefore, be on his guard to secure, if possible, the services of a really independent expert. It is universally agreed that the fundamental requirement for the ventilation of all classrooms and assembly rooms is the supply of 30 cubic feet (or a trifle under one metre cube) of fresh air per minute for each pupil up to the maximum number allowed for the room in question; while the heating plant should be adequate to raise the temperature to 70° Fahrenheit in zero weather. All the textbooks and handbooks on heating and ventilation contain formulæ for calculating the square feet of radiating surface required to accomplish this under varying conditions, for hot water, steam and hot air respectively; and also formulæ for horsepower of boilers, area of furnace grate surface, and size of chimney stacks for given areas of radiation. These enable the architect to figure the data for the required plant himself, if he choose, or to go over and check the figures of bidders who may offer their various systems in competition. In any case, the architect who has thus figured out independently the requirements of his building will be in a better position to discuss matters with his engineering expert, as well as with competing heating companies, than one who has to rely implicitly on the figures they supply.

But however perfect the heating and ventilating plant, and however faultless its operation, let it be clearly understood and always remembered that no artificial heating and ventilation can ever take the place of fresh outdoor air and sunshine. Every room that is ever occupied for any length of time by human beings should, if possible, be so placed as to receive at some time in the day the direct rays of the sun and the fresh breezes of the outer world, and no matter how abundantly ventilated by artificial means, it should have its windows thrown wide open for a while every day, when not occupied, to allow free access to the outside air. This is not always possible with theatres in crowded cities, and they are consequently obliged to devote an otherwise quite disproportionate expense to their ventilating equipment. But no schoolroom, classroom or gymnasium or assembly room should be so placed—if it can possibly be avoided—as to be deprived of these important adjuncts to the mechanical supply of heat and fresh air. Whatever the scientists may say, it is indisputable that there is a sweetness and life in the air of a room that has been sunned and aired from the outside that can be obtained by no other means. Air blown by fans over coils of heating pipes can, at best, only prevent the undue exhaustion of the oxygen in the room, and is often powerless to remove the odors and stuffiness produced by a crowd of human beings, though these odors will entirely disappear after all the windows have been opened for five or ten minutes. The placing of the auditorium in the centre of a solid block of buildings, surrounded by corridors on all sides, lighted only from overhead and ventilately solely by artificial means, is to be avoided, though it is often the easiest solution of the problem. If courts, even of moderate size, can be interposed to flank such an assembly room, the plan is vastly improved. Both the corridors and the auditorium by this means receive direct outside light and air. In a large high school in New Jersey, which has been the object of some notice in the northern part of the State, the auditorium, seating over 1000, is wholly enclosed by corridors with windows opening directly into it, so that any vitiation of the air in one is shared by the other, and neither it nor the corridors ever receive the direct light of day or a breath of air directly from out of doors. The arrangement is to be condemned from every point of view, and if not positively unsanitary is, at least, unsatisfactory, inartistic, and it is lacking in cheerfulness.

Window-Lighting. The width of the area effectively lighted by windows opening upon open spaces or wide streets not lined with excessively tall buildings is in our brilliant North American climate about twice the height of the window-heads from the floor for classrooms, as has already been remarked. In other words, the section of adequate lighting is a right-triangle having a base equal to twice its altitude—that is, with an acute angle of 28° 15′—and the desks should be so placed that the furthest from the window should have its top at least partly within this triangle. Where the windows open upon a court of moderate size, upon a narrow street, or upon a street of fair width but lined with very high buildings, this is too large an allowance; the rooms should be reduced from 10 to 20 per cent. in width. The ideal solution would be one in which a ray at 28° 15′ coming over the roofs of average height on the opposite side of the street would just touch the window-sills of the lowest classroom in the school. In populous cities this cannot always be realized, but on the more open sites available in suburban towns it is always practicable. Theoretically, a line drawn through the window-head, parallel to one connecting the window stool with the shadow-casting edge of the wall or roof opposite, will, if the inclination be steeper than the conventional angle of 28° 32′ determine by its intersection with the floor the width of the efficiently lighted area of the classroom. When the angle is equal to or less than 28° 32′, the case enters the normal category and falls under the general rule. Of course, when the resulting diagram reduces the width very greatly—*e. g.*, when the inclination of the tangent ray from roof to sill is steeper than, say 35°, one must compromise. The rooms will have to be made wider than the diagram would allow and the windows increased in width to make up for part of their inadequate height, or the

story must be made higher; or, better still, the building set further back from the street. In any building in which the inefficient lighting on the lower floor cannot be remedied, as few classrooms as possible, or none at all, should be placed on that floor. That a hundred pupils should have a flight of stairs to climb is a far less evil than that twenty of them should have their eyesight injured.

Bilateral lighting is permissible only in wide study-rooms or laboratories, when 35 or more feet in width, and in auditoriums. Avoid placing windows opposite the teacher's desk in corner classrooms and opposite the seated audience in an assembly room. Avoid also any great expanse of windows opposite the speakers on the platform. The ideal audience room has light from the two sides, with additional light from overhead if necessary.

Toilet-rooms and Cloakrooms. These are the subjects of more controversy than any other feature of school design. Toilet-rooms are sometimes grouped in the basement, sometimes placed on all the different floors, sometimes grouped on each floor, sometimes scattered so as to connect one with each classroom or pair of classrooms, sometimes two systems are combined. Every system thus far tried has its drawbacks. To require every pupil to go to the basement in order to use a lavatory or water closet is not only unkind and unsanitary (seriously so in cases of sudden and severe illness), but resort to the basement easily becomes a means for gathering of pupils during class hours for mischief, play, or other purposes not legitimate to the place and time. The basement toilet-rooms are, however, less expensive to install and maintain than scattered toilets. In any case a fair allowance of toilet-rooms for boys and for girls should be assigned to the basement for use during recess and at the times of entering and leaving the building, as well as in connection with the gymnasium and baths, if such be provided.

When toilets are also provided on each floor, as they ought to be, the problem is one of distribution. Those for the two sexes should, of course, be as completely and widely separated as possible. Economy suggests their arrangement in stacks or towers, or at least in vertical superposition throughout. When the stories are not less than 14 feet high in the clear the toilets for boys may be placed so as to be reached from the half-way landings of the stairs, and for girls at the ends of the corridors on the floor-levels, over those for the boys, the toilet-rooms being seven feet high in the clear. This completely separates the sexes and is economical of cubic contents, but requires special planning of the corridors to give access to the girls' toilets, and moreover it generally cuts off light from the stairways. It is not, therefore, ordinarily practicable. When they are grouped in two towers or stacks, one for each sex, projecting outwardly to the rear or into a court, it is possible to separate them from the corridors by short intermediate entries provided with cross-drafts from opposite windows; this gives absolute protection against any intrusion of odors or foul air into the corridors. Moreover, it places the entire system of piping outside the main structure, where leaks cannot injure other rooms and repairs need not disturb the school work. It is sometimes objected that this isolation of the plumbing is needless, as good plumbing and ventilation perfectly guarantee freedom from noisome odors, but this is not quite true. Fixtures and toilet-rooms used by considerable numbers of persons in a short space of time always give forth some odor for a while after such use; moreover, not all school plumbing and fixtures are always kept in perfect condition, and the school should be protected against the consequences alike of accident and misuse. This, together with the greatly increased cost, constitutes a serious objection to the general adoption of the plan followed in some Ohio schools, in which each cloakroom adjacent to a classroom has connected with it a water closet for the use of the pupils in that classroom. This keeps the use of the toilet wholly under the teacher's control, but it compels the use of the cloakroom as a thoroughfare, which is a serious objection; makes the use of the toilet unpleasantly public and immensely increases the cost of the installation as well as the danger of annoyance from occasional accident or misuse.

No one solution is, therefore, ideal, and as the value of one or another system depends greatly on the discipline, character and traditions of the school and its pupils, these must be considered by the architect in conference with teachers and school officials in deciding which system to adopt.

It goes without saying that every toilet-room, even the small ones attached to teachers' rooms and principal's office, should have direct light and air from out of doors, and that specially careful provision should be made for mechanical ventilation of all the pupils' toilet-rooms.

Cloakrooms. Two chief systems are in use for the care of pupils' outer clothing; general cloakrooms in the basement, and class cloakrooms on every floor. The advantage of the first of the two systems is that pupils leave behind their outer clothing upon entering the building and take it again only on leaving. Thus muddy overshoes and damp coats and cloaks are not carried up into the corridors or classrooms of the building. The disadvantages lie in the difficulty of supervising the crowds of pupils at the times of entering and leaving the building, and the danger of pilfering in the cloakrooms. To obviate these difficulties individual lockers are provided in some schools, the pupil having a key which opens only his own locker. But this provision of lockers requires a great amount of space, is costly, and subject to the annoyance of frequent loss of keys. It can only be applied where space and funds are generously ample.

The class cloakroom system provides a long and narrow cloakroom or closet next each classroom. This has the disadvantage of requiring pupils to come through the halls to their classrooms before taking off or disposing of their outer clothing. On the other hand, the wraps, hats and overshoes so disposed of are always under the teacher's supervision, and the congregating of several hundred boys or girls in the basement at the close of school is avoided. Class cloakrooms should never jut into the hallways. They are best placed transversely, with an outer window at one end, and with two doors opening into the classroom. They should never

be used as thoroughfares, and hence should not open into the corridors. Whether they should be placed behind or opposite the teacher's desk is usually determined by circumstances. They should always be provided with forced ventilation, and especially strong aspiration, so that air may be drawn from the classroom through the cloak closet, and not move in the reverse direction. One end may be divided off by a wire mesh or grill screen to form a teacher's coat closet. The hooks should be spaced on each wall about 12 inches apart and alternately at a higher and lower level, so that in a given row they will be two feet apart. This makes for ease in finding one's own hook. The heights of the two rows should be adapted to the average size of the pupils of the grade using the classroom.

Whether the class cloakroom or the general basement cloakroom should be adopted in a given case depends largely upon the regulations prevailing for entering and leaving the building. The class system is more often used in grammar and primary schools, and the general cloakroom in high schools, with or without lockers. But there is no absolute rule in the matter.

Construction. A schoolhouse should represent the most thorough and careful construction possible, both as to materials and execution. Ornate finish is unnecessary, but good taste and refinement should appear in all the details. It is wise economy to make the floors, wainscotings, stairs and hand-rails all of the most durable materials, even at considerably increased expense. Ceilings should be generally of white plaster to reflect and diffuse the light, but walls should be tinted of some quiet, restful and pleasing hue. Tile wainscoatings in corridors and stairways are sanitary, durable and indefaceable. Wooden wainscoatings should be avoided generally in such places.

The fundamental question is, however, not that of the finish, but of the framework or shell of the building. This ought to be always of fireproof materials. The time is coming when the use of inflammable materials in the construction of schoolhouses (except small and poor rural district schools) will be considered little short of a crime. Unfortunately, not every school board or community has as yet reached the point where it thinks it can afford really fireproof construction. Where this is then not possible, it should be absolutely insisted upon that all the corridors and stairways should be fireproof; that is, built of non-combustible materials, all iron framing being protected; that all plastering should be upon wire lath, and that wooden furring should be prohibited; that the boilers and furnaces should be in a thoroughly fireproof room, and that the building should be equipped with one or more standpipes and hose in conspicuous and central locations on each floor. And since in even a fireproof building smoke from some trivial local fire not really at all dangerous may spread through the building and possibly create a panic, the stairs and corridors should always be so planned as to offer the most ample and direct exit from all parts of the building. The danger of panic furnishes a reason additional to those named earlier in this article for avoiding the placing of the assembly hall in the topmost story of the building, particularly if the hall is liable to be used for public purposes or audiences not wholly composed of pupils. For while the pupils may be trusted to make an orderly fire-drill exit in case of emergency when by themselves, a miscellaneous audience is easily thrown into panic and may communicate its disorderly fright even to the otherwise orderly and well-drilled pupils.

Let the school building, then, be solidly constructed, thoroughly fireproof, abundantly lighted, with adequate, straight halls and ample stairways, having sunshine and access for the outer air in every room besides abundant forced ventilation; let it be cheerful and attractive without and within, well placed and supplied with adequate playgrounds and pleasant surroundings, and it will be not only a source of pride, but a blessing to the community, as well as a credit to its designer.

BISHOP CHEVERUS SCHOOL, EAST BOSTON, MASS.

MESSRS. BRAINERD & LEEDS, ARCHITECTS

TWO EXAMPLES OF ECONOMICAL FIRE-PROOFING IN SCHOOL HOUSES

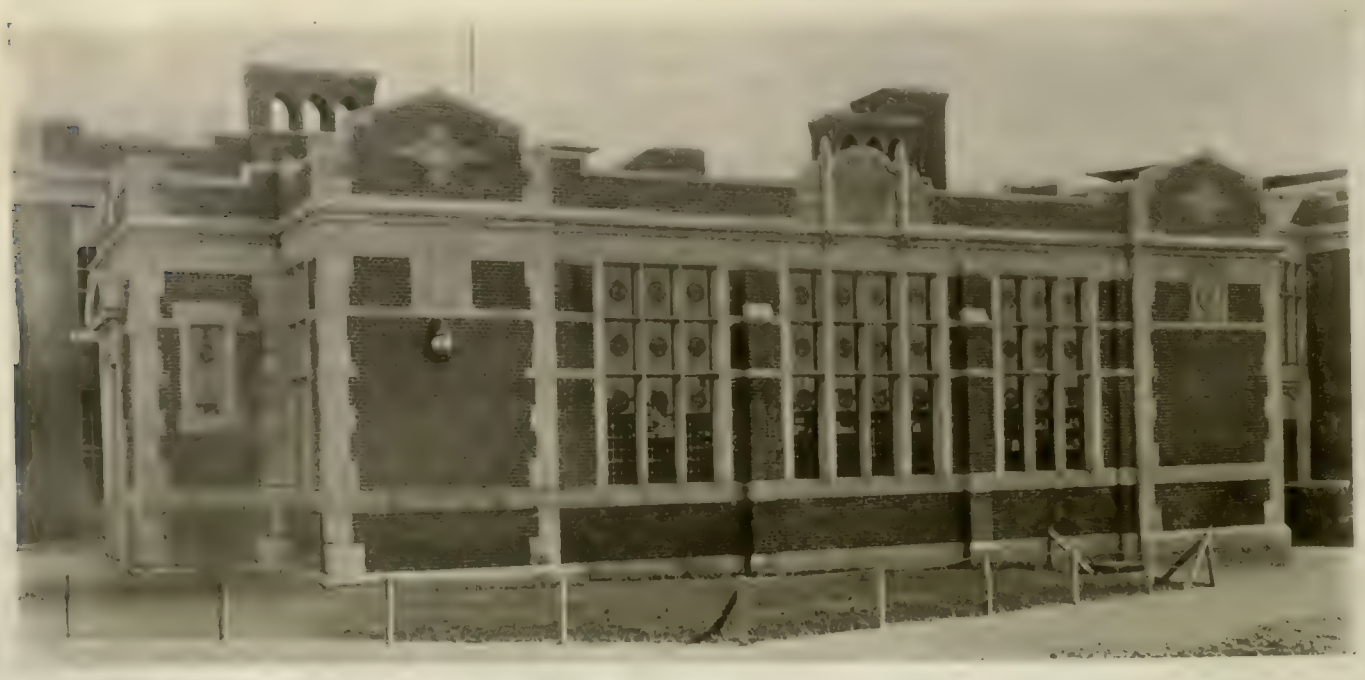
BY WILLIAM H. BRAINERD.

The first was the *Daniels* Grammar School for the city of Malden. This contains 14 classrooms and assembly hall with the usual accessories. The buildings previously erected by this city had their floors and interior walls of wood, and financial conditions were such that they were unwilling to materially increase the expense of the construction.

The only space available for the hall, within our means, seemed to be in the roof.

This gathering of the entire school at the top of the building demanded absolute safety of exit. This put before me the problem of how to gain this without large increase in cost. The first move was to use brick walls for all main partitions. It was found that where these were incorporated with the heat and vent flues, so that they replaced galvanized ducts and the furrings about them as well as a stud bearing partition, the cost was actually reduced; furthermore, the brickwork could be carried up to form the top of the vent flues in place of the metal frequently used. Such tops have two advantages over metal, greater permanence and less cost. The change from wood to brick in walls without flues did somewhat increase cost, but did away with all necessity of buttresses for exterior walls or of interior bracing to stiffen the building. The remaining stud partitions were few and were set on strips of metal on top of the floors or were filled with brick where they passed through the floors. This divided the building into six brick boxes and eliminated all vertical concealed spaces where fire might spread. Plastering wherever possible was applied directly to the brickwork. Exterior walls were lined with hollow brick and coated with asphaltic paint before plastering.

To remove the most frequent source of fire originating from within the building, or being communicated to it, the boilers were placed in a room entirely outside the

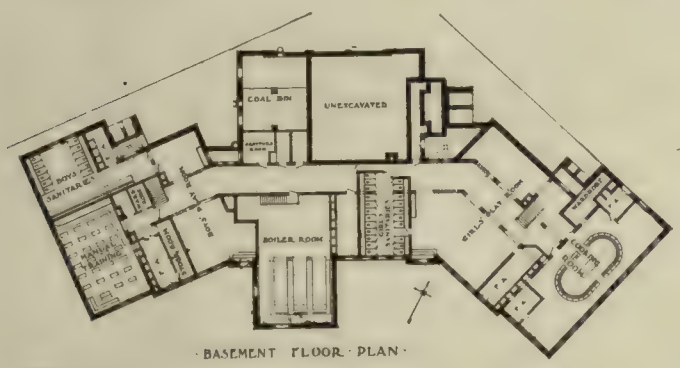


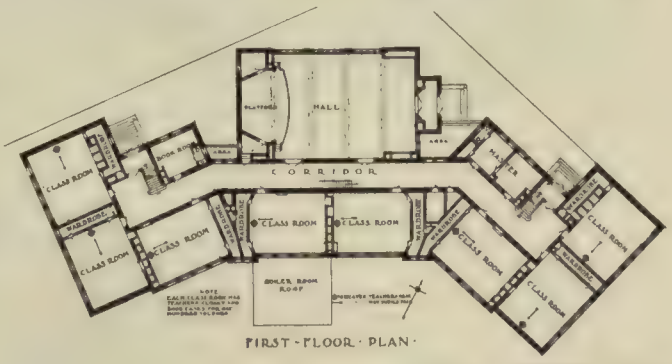
BISHOP CHEVERUS SCHOOL, EAST BOSTON, MASS.

MESSRS. BRAINERD & LEEDS, ARCHITECTS

walls of the building and covered with a roof of reinforced concrete, and the single connecting opening protected with a tinned fire door. This, too, added a little to the cost, but increased the playroom space of basement and kept the building free from all dust arising from fuel or ashes. These features greatly reduced the chances of origin and spread of fire, but the floors of corridors and exits were still in danger from any fires which might start in closets or similar places beneath them. To obviate this, we decided to make all corridor floors of reinforced concrete spanning from brick wall to brick wall with a finished surface of magnesium cement carried up the walls six inches to form a sanitary base.

All stairs were of iron. All exits were now enclosed with incombustible floors and walls, and the woodwork in them reduced to the doors with their frames and wardrobe posts and rails, so that we believed them to absolutely safe. The additional cost of the concrete construction and cement floors for corridors over hard pine joist with maple upper floors, was about $1,500. To partially compensate for the extra expenses, we omitted the high hipped roofs over the end wings where space was not needed for rooms. This saved many cubic feet of construction and permitted the use of a roof covering—more economical both in first cost and in maintenance. Besides reducing cost, this did away with an open attic where trash might accumulate increasing the fire risk. It also gave an opportunity to express the assembly hall architecturally. The great gable windows, buttressed by the grouped vent shafts, have proved to be the feature of the building.





FLOOR PLANS

BISHOP CHEVERUS SCHOOL

The lighting of the hall by the large windows high up on the sides, is one of the most desirable forms of illumination, similar in effect to a clearstory in a church, or a monitor in a mill.

The exterior of the building is of selected red sand struck brick laid with gray joints and trimmed with Indiana limestone and gray brick. The building in general is planned to fill the requirements of the Boston Schoolhouse Department in window area, finish and fittings. The interior finish is of chestnut. Floors of rooms are maple. Each classroom has exposure to sun during some portion of the day, is 26 x 32, and is supplied with slate blackboards on three sides—contains a bookcase and a teacher's closet. A wardrobe for each sex is provided with every classroom.

Heating and Ventilation.—The system for steam is low pressure with gravity return. The system for air is gravity. The ventilation is stimulated by aspirating coils placed in the vent flues. A small heater is provided to heat these and to provide hot water for baths and bowls when the main boilers are not in operation. There are two horizontal return tubular boilers, either of which will handle the building in ordinary winter weather.

Each classroom is warmed by direct radiation and has an air supply of 30 cubic feet a minute per occupant brought through brick heating chambers with pin radiators in basement.

The temperature is controlled by hand mixing dampers operated by the teachers.

The first story corridors have foot warmers. Teachers' and Master's rooms are heated by direct radiation.

Toilet Ventilation.—All closets have seat vents of extra size, these, with the space behind urinal, are connected to separate heated flues which extend to the top of main stacks. Each basement toilet and bathroom has its separate vent flue heated with an aspirating coil.

Electric Construction.—The building has an interior telephone system of 16 stations, a system of program bells under control of a master clock; wiring for a system of electric clocks, and wiring for electric lights throughout.

Gas Piping is installed for emergency lighting in corridors and assembly hall.

The 14 classrooms each seat 56 pupils, or a total of 784. The cost per pupil was $100.18. The cost per cubic foot was 12.9 cents. This covers building, heating, plumbing and electric construction and includes the six shower baths for each sex. The total cubic contents of the building is 608,114 feet.

The second example is the *Bishop Cheverus* Schoolhouse, East Boston.

The following description is compiled from the Annual Report of The Schoolhouse Department of the City of Boston for 1908-09.

The Bishop Cheverus elementary school, upper (grammar) grades. This building is located on land surrounded by four streets in East Boston, and owing to the fact that it was a large lot, the Board felt justified in trying the experiment of an extended plan, with all the classrooms on the first or second floor, and with the assembly hall on the first floor immediately

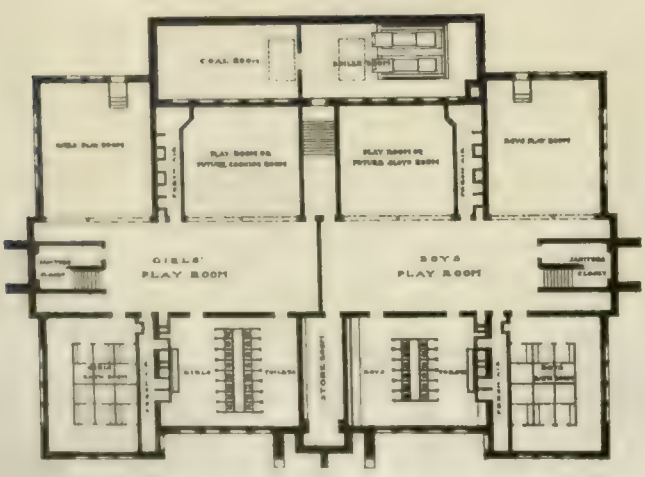
DANIELS SCHOOL, MALDEN, MASS.

MESSRS. BRAINERD & LEEDS, ARCHITECTS

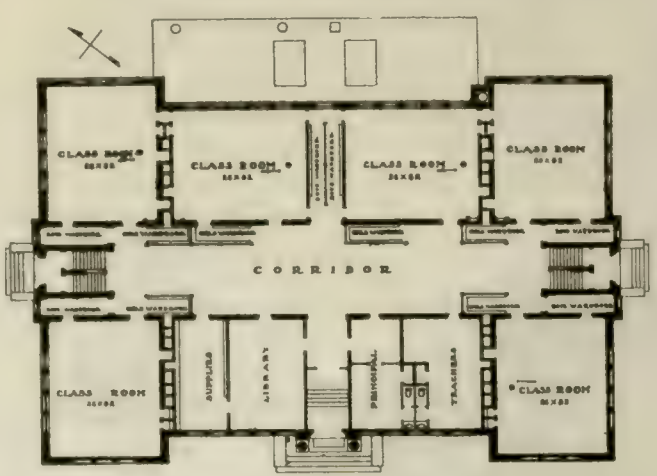
accessible from the outside without entering the building. The boilers also are located outside the line of the building. The rooms are so arranged as to give sunny exposure for all the classrooms, and, notwithstanding the extended plan, the figures prove that this building is as economical as any of its size and type that has been erected by the Board.

The basement contains the playrooms, toilet rooms, manual training room and cooking room. There are eight classrooms and an assembly hall on the first floor and eight classrooms on the second floor, all of the standard 23 x 29 dimensions, to seat 44 pupils.

Heating and Ventilation.—System: The system for steam in this building will be low pressure, gravity return. The system for air will be gravity. The ventilation will be stimulated by means of aspirating coils placed in the vent flues. Boilers: There will be two horizontal return tubular boilers of 78 horsepower each, 60 inches in diameter and 18 feet 4 inches long, containing 72 3-inch tubes 17 feet. long. Radiation: There will be a total of 12,241 square feet of radiating surface. Classrooms will be warmed by indirect pin radiators generally placed in brick heating chambers in the basement. Foot warmers encased in galvanized



BASEMENT FLOOR PLAN



FIRST FLOOR PLAN

DANIELS SCHOOL

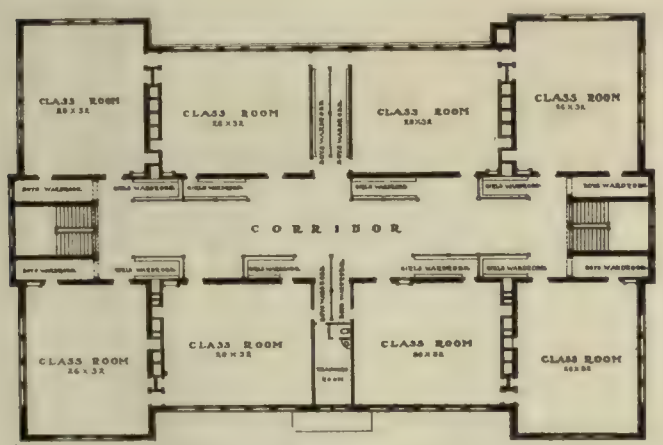
MALDEN, MASS.

iron and suspended from the basement ceiling are provided for the first floor corridor. Direct radiation will be placed in the wardrobes, masters' and teachers' rooms and also in the basement playrooms and sanitaries. Temperature control: The temperature of the air entering the classrooms will be controlled by means of hand mixing dampers operated by the teachers. Fresh air will be supplied to the manual training and cooking rooms in the basement by two 24-inch propeller fans belted to electric motors.

Toilet Ventilation.—All water closets in the basement sanitaries will be provided with outlets for seat ventilation which will be connected together by means of galvanized iron ducts and run in two separate flues to the top of the main ventilators. Connection will also be made to the space back of the urinals. Ventilation will be assisted by aspirating coils placed in the main flues. The individual closets have similar seat vents.

Warm Air and Vent Flues.—These will be built of brick instead of galvanized iron as has been the former practice.

Electric System.—The building will be equipped with



SECOND FLOOR PLAN

DANIELS SCHOOL MALDEN, MASS.

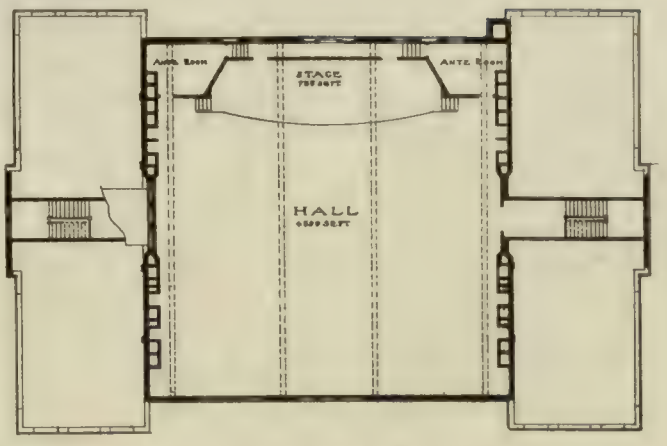
electric lights, a telephone system for interior communication, a system of electric clocks controlled by one master clock, a system of program bells also under control of the master clock, a combined local and auxiliary fire alarm system, and a projection lantern with reflectoscope attachment for the assembly hall.

The contracts are as follows:

General contract	$81,392
Heating contract	17,795
Plumbing contract	4,875
Electric contract	4,844
	$102,906

This building on the basis of a 16 room, upper elementary, with an assembly hall, was rated at 18 rooms, 30,000 cubic feet per room and 22 cents per cubic foot or $118,800. It has been let considerably below this amount and the cost per pupil will be in the neighborhood of $160.84. This was figured at a favorable market, and it is not likely that these prices will be readily duplicated.

The cost per pupil was fixed (See Report for 1906-07) at $174 to $192 for upper elementary (grammar grades).



THIRD FLOOR PLAN

DANIELS SCHOOL MALDEN, MASS.

Here the cost per pupil in the upper elementary is $162, which is below the low limit for large buildings. The total cubic contents of the building is 544,000 feet. Cost per cubic foot, 19 cents.

NOTE.—The cost per pupil is reckoned on 40 pupils per classroom, the average use—not on 44 pupils per room the full seating capacity.

It is interesting to compare the results in this case with the averages of the Commissions work to date:

Total number of new buildings erected by Commission 1904-09	29
Total number of children accommodated, lower elementary	9,530
Total number of children accommodated, upper elementary	10,650
Average cost per pupil, lower elementary (primary)	$162.83
Average cost per pupil, upper elementary (grammar)	197.13

The results were attained in much the same manner as in the *Daniels* School.

The exterior is of selected sand struck brick with trim of Indiana limestone.

All ducts and bearing walls were made of brick. The exterior walls were lined with hollow brick and coated with asphaltic paint before plastering. The floor construction is of reinforced concrete. Floor beams are adapted to the spacing of ceiling lights and are left exposed. Corridors are spanned with plain slabs. The stairs are concrete with iron strings and balustrades. Classrooms and offices have a single matched maple floor nailed to screeds 16 inch o. c. The screeds were nailed to the stone concrete slabs and then filled flush with cinder concrete.

The structural slabs in the corridors and wardrobes are finished with a granolithic surface.

The floor of the assembly hall is battleship linoleum glued to the concrete. Flat roofs with parapets are used throughout. An interesting feature of the assembly hall is the medallions of the leaded glass window which give in proper colors the seals of the 46 States of the Union. The carved decorations of the façade of the hall are the Seal of the City of Boston at the center and on the end pavilions the Coats of Arms of the United States and the Commonwealth of Massachusetts.

THE HEATING AND VENTILATION OF SCHOOLS IN CONGESTED CITY DISTRICTS

By FRANK G. McCANN,

Member Am. Soc. Heating and Ventilating Engrs., Chief of Heating and Ventilating Division, Board of Education, New York

THE problems involved in the heating and ventilation of the school houses to be built in the congested districts of a great city, while in general very much the same as those found in the same style and size of building in the more open country, yet present some special features not found in the latter.

One of the principal special features is the exceedingly compact arrangement of plant made necessary by the massing of a large number of rooms on a small ground area.

The street floor in such a building is almost entirely given up to playrooms or auditorium (see Fig. 1), making it impracticable to use vertical heat flues from cellar to supply each individual room with fresh air. To obviate this difficulty we have adopted the system shown in Fig. 2, whereby all the fresh air for one story or a section of one story is brought up to ceiling of said story and there is distributed in furred space under ceiling of corridor with two inlets to each room. Each inlet in every room has a wire screen, and back of same in neck of room runout we place an adjustable diffuser (see Fig. 3), of which each blade can be separately set to give a uniform flow of air through all portions of the inlet at a velocity of about 200 feet per minute. This is too slow to cause drafts.

The cellar arrangement for above work is shown by Fig. 4.

The foul or vitiated air in our schools is removed from the classroom proper through wire screens in the several doors of the pupils' wardrobe, and therefrom through a wire mesh screen in end or top of wardrobe. The screen in end is made full height of wardrobe—7 feet—and no coat hooks are placed over same, so that clothes cannot prevent free discharge of vitiated air into the vent flues. This scheme obviates the need of steam coils in wardrobes, as the vitiated air is sufficient to thoroughly dry the clothing even in wet weather. and overheating of classrooms by coils in wardrobes is thus also prevented.

In this system the vent flues are usually run straight up through roof and are capped on top with special vent hoods having an aspirating effect. In some cases, where attic is used for lunch rooms or gymnasiums, to avoid interference of such vertical flues with the free floor space or to avoid the rather unsightly appearance in case of steep-pitched roofs, we gather the vent flues together under ceiling of top story in furred spaces and use exhaust fans to overcome the friction incidental to such long horizontal offsets.

Another difficulty encountered in the design of the school in congested districts, and one of which the importance cannot be overestimated is the difficulty in obtaining pure air for ventilation.

In Western cities, where soft coal is used for steam plants, the all-pervading soot from the soft coal smoke makes it compulsory to install some form of air-washing device to eliminate this soot. In the Eastern cities, however, where anthracite coal is most generally used, soot is absent, and in clean surroundings air washers may be omitted without serious detriment to the plant if funds are not ample to include same.

The writer believes, however, that air washers and humidifiers will soon be demanded by good practice for all ventilating plants and urges their general adoption as essential to the health of the occupants.

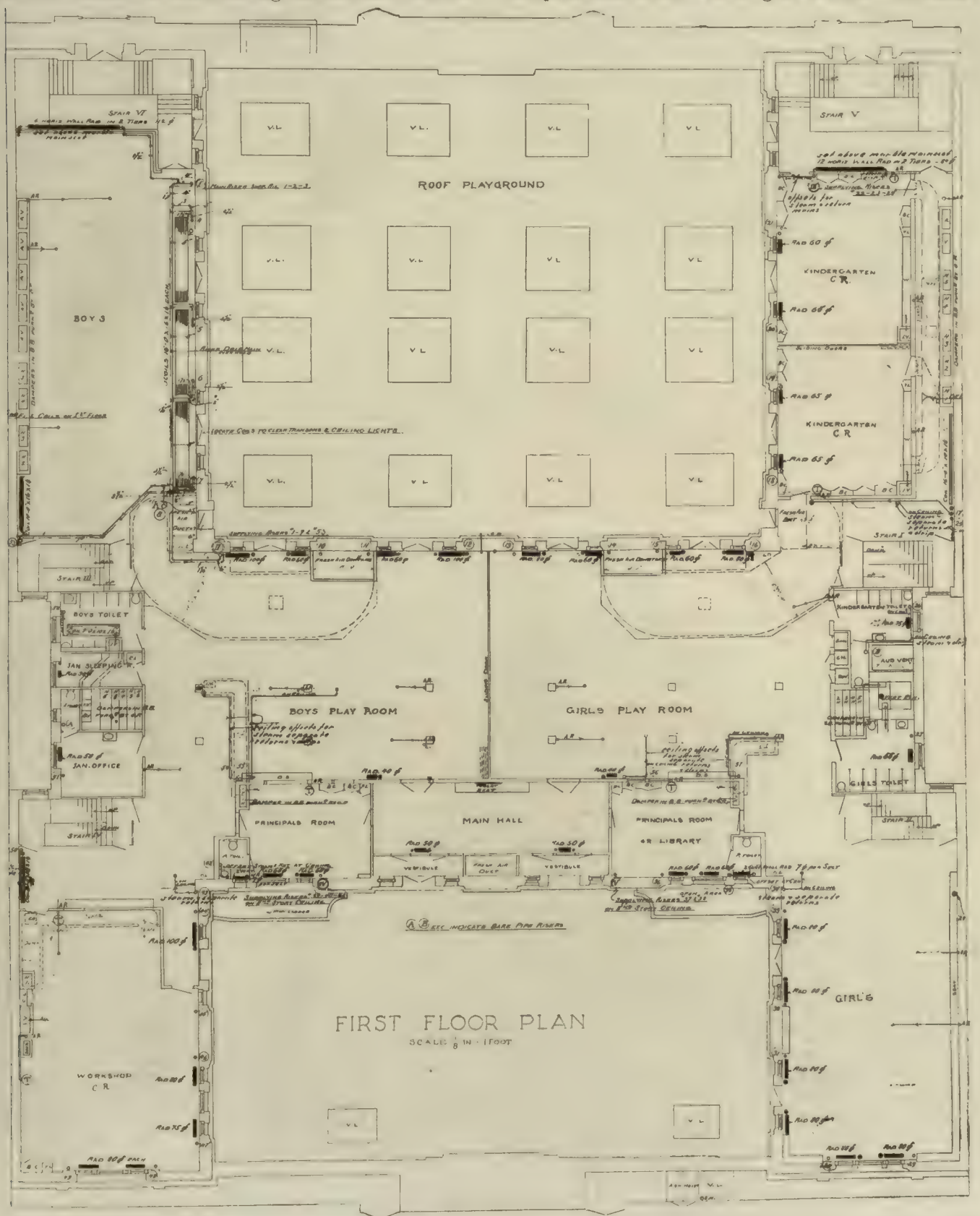
In cases where no air washers are installed it is essential that the fresh air supply be taken from a point at least 25 feet above ground level in order to avoid the indrawing of street sweepings and other filth which the winds will often raise several feet into the air. It is also absolutely essential that the air supply be taken from a point where it will always be free from contamination by noxious gases emanating from toilet vents, smoke flues, etc.

It is our practice, even where air washers are used, to draw our air from about mid height of the building, thus getting the air as pure and as free from contamination as possible. This can be done without detriment to the architectural ef-

SHOWING FRESH AIR INLETS, PUBLIC SCHOOL BUILDING
NEW YORK CITY
MR. C. B. J. SNYDER, ARCHITECT

fect, as is shown by Fig. 6. A typical arrangement of fresh air inlets, heating chambers, etc., for a large building is shown in Fig. 5.

In buildings of this character it is customary to use the auditoriums for holding assemblies, for study halls and for classes in music during school hours and for lectures, entertainments, mothers' meetings, etc., outside of school hours. This varied use of auditoriums makes necessary a separate blower, engine and heating chamber for heating and ventilating the auditorium independently from the rest of the building. For quick and effective heating as well as ventilating



FIRST FLOOR PLAN, PUBLIC SCHOOL 100, BOROUGH OF MANHATTAN, NEW YORK CITY — MR. C. B. J. SNYDER, ARCHITECT

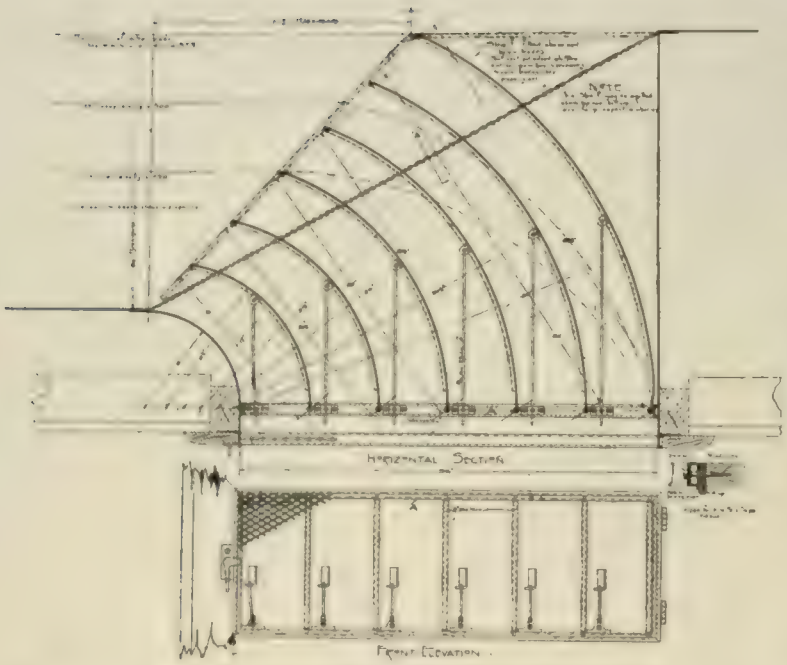


FIG. 2

of such a room there seems to be nothing superior to the hot-blast system with uptakes in front of windows (see Fig. 7) or under ceiling and under gallery (see Fig. 8) as best suits the case, with indirect surface forming reheaters at the base of each uptake and controlled by thermostats of which there must be enough, properly placed, to give a uniform temperature throughout the room (of course, the double-duct system may equally well be used if better suited to building conditions).

The vents in such case should be through grilles in front of stage and through cast-iron registers in floor placed in several rows in aisles, so that all parts of room will be equally supplied with fresh air. Upward ventilation is not well adapted to such auditoriums, as they are usually less than 25 feet high, mostly being one story high, and the dirt brought in on shoes also militates against this system, even in high rooms, if floor registers are used. In very high auditoriums where permanently set opera chairs having special hollow legs can be used to admit a supply of fresh air at each seat, upward ventilation with a modification of the double-duct system is advisable and requires less air for satisfactory operation than would be needed for downward ventilation.

An item worthy of passing mention is the need for care in designing floor registers in order that the openings shall not be large enough to permit the entrance of the heels of ladies' and children's shoes, as a panic may be started by even so trivial an incident as that.

The temperature of all rooms, etc., and of the air supply, must, of course, be automatically controlled by the use of some system of temperature regulation, in order that the busy teachers may not need to divert their attention from their official duties to adjust heating appliances, which they naturally will not do until the conditions are intolerable. We also control the temperature at which the thermostats on our fresh-air ducts function, by means of a special thermostat placed out of doors, thus causing the temperature at which fresh air is supplied for ventilation to change to suit the outdoor conditions, and overheating is thereby obviated. The theory of this outdoor control is shown by Fig. 9.

It is generally considered the best practice to use blowers for supply of air at 65° to 75° Fahr. for ventilating purposes only, and to use direct radiators or coils placed under windows in classrooms for heating independently of the blowers. This system is valuable in that the heating surfaces

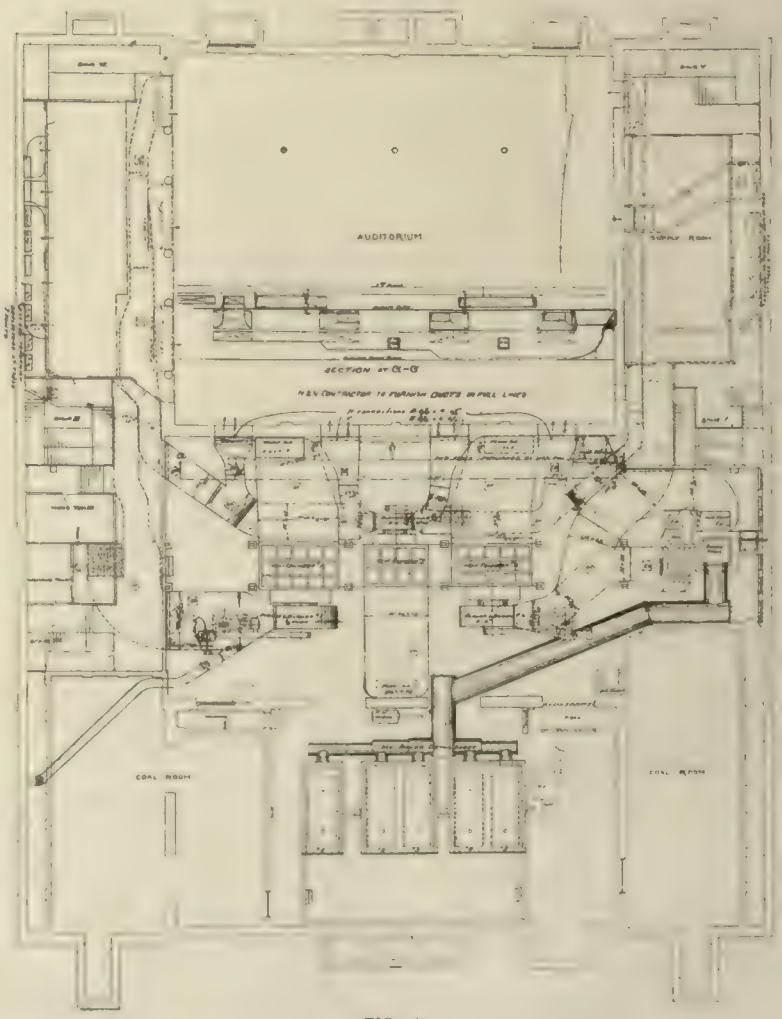


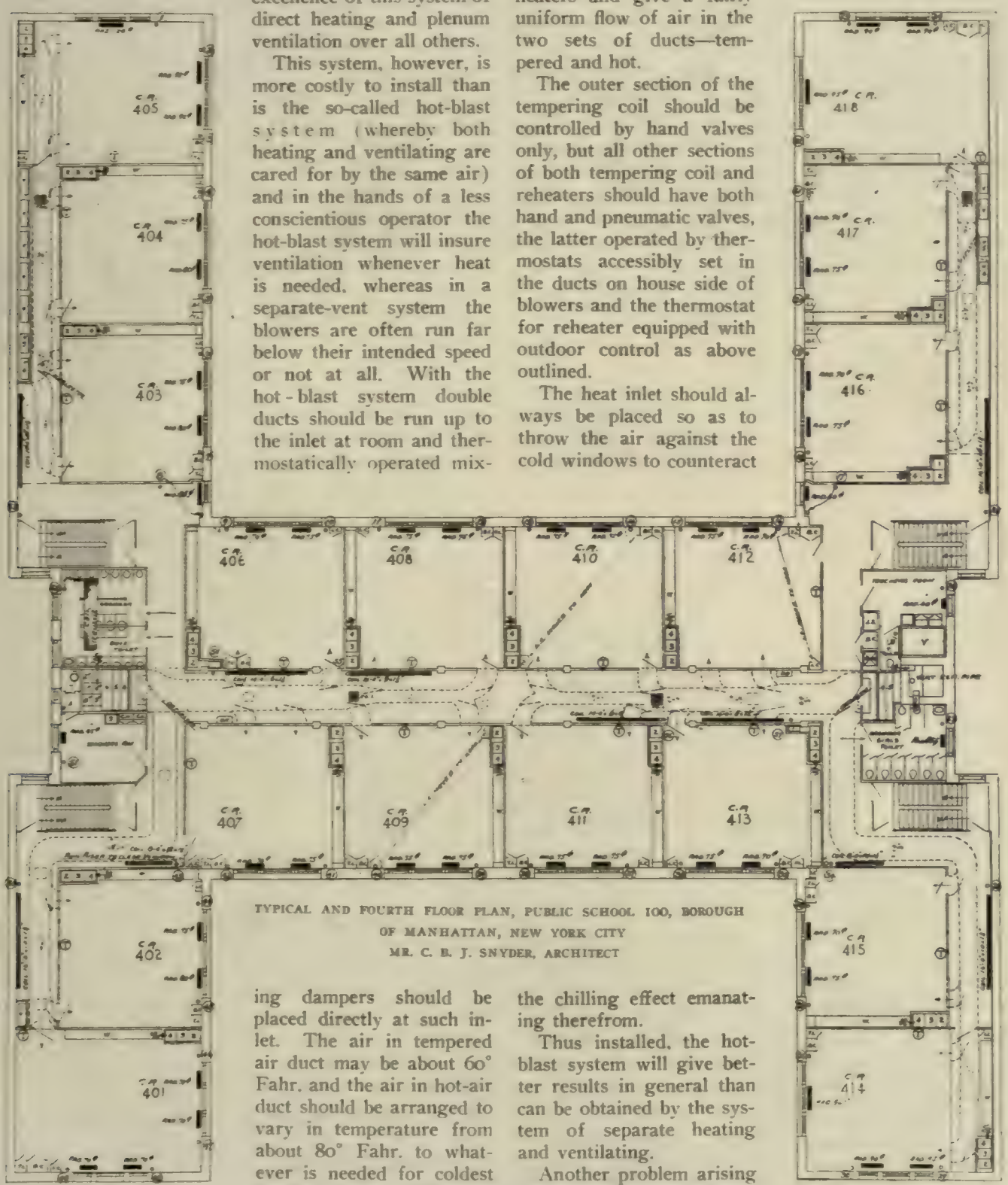
FIG. 4

are placed where they will most quickly and effectively counteract the draftiness and chilling effects of cold windows and walls and also that heat may be supplied without the use of the blowers after school hours in cold

weather as well as during school hours in mild weather, when teachers refuse to close windows.

If carefully operated by conscientious help, there is no doubt in the writer's mind as to the superiority and excellence of this system of direct heating and plenum ventilation over all others.

This system, however, is more costly to install than is the so-called hot-blast system (whereby both heating and ventilating are cared for by the same air) and in the hands of a less conscientious operator the hot-blast system will insure ventilation whenever heat is needed, whereas in a separate-vent system the blowers are often run far below their intended speed or not at all. With the hot-blast system double ducts should be run up to the inlet at room and thermostatically operated mixing dampers should be placed directly at such inlet. The air in tempered air duct may be about 60° Fahr. and the air in hot-air duct should be arranged to vary in temperature from about 80° Fahr. to whatever is needed for coldest weather, but should not exceed 120° Fahr. The quantity of air supplied to each room and the total heat losses for exposed wall and glass in addition to heat required to warm the ventilating air in each case in coldest recorded weather will, of course, determine this necessary maximum temperature.



TYPICAL AND FOURTH FLOOR PLAN, PUBLIC SCHOOL 100, BOROUGH OF MANHATTAN, NEW YORK CITY
MR. C. B. J. SNYDER, ARCHITECT

The temperature at which the "hot-air" or "reheater" thermostat functions should be controlled by a special outdoor thermostat of type shown in Fig. 9, hereinbefore mentioned. This will economize on steam in the reheaters and give a fairly uniform flow of air in the two sets of ducts—tempered and hot.

The outer section of the tempering coil should be controlled by hand valves only, but all other sections of both tempering coil and reheaters should have both hand and pneumatic valves, the latter operated by thermostats accessibly set in the ducts on house side of blowers and the thermostat for reheater equipped with outdoor control as above outlined.

The heat inlet should always be placed so as to throw the air against the cold windows to counteract the chilling effect emanating therefrom.

Thus installed, the hot-blast system will give better results in general than can be obtained by the system of separate heating and ventilating.

Another problem arising with either system of heating is to heat principal's and similar offices to 70° Fahr. after school hours and on holidays while the rest of the building only needs to be kept above freezing. It would seem that gas radiators would be more economical than steam for this purpose were the gas radiators only used

when no other heat is available and then only when room is actually in use. If gas is not available for this purpose, the steam from one boiler only may be used for heating such rooms by means of separate steam and return lines direct from boiler to these rooms at the same time permitting a safe temperature to be kept on the rest of the building by vapor from other boilers.

In case this is done, by-passes must be arranged so that during school sessions these special lines may be connected into the regular heating mains, and valves (including a safety valve set at 10 lbs. on house side of stop valve in steam line from boiler and a swing check in return to boiler) must be very carefully located for easy and sure operation by janitor, to prevent high-pressure steam reaching such special radiation.

All the boilers in such a building, unless an electric generating plant is installed, should be run high pressure, say 60 to 80 lbs., during school hours to furnish steam to drive the ventilating fans or blowers by steam engines, the exhaust steam from such engines being used in the heating system after being passed through a suitable grease extractor. Live steam at reduced pressure should be supplied to make up the required additional steam for

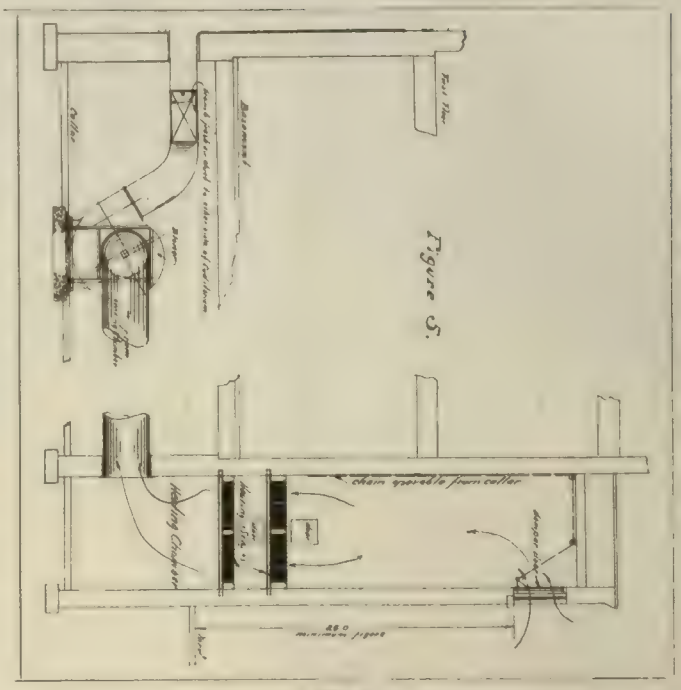
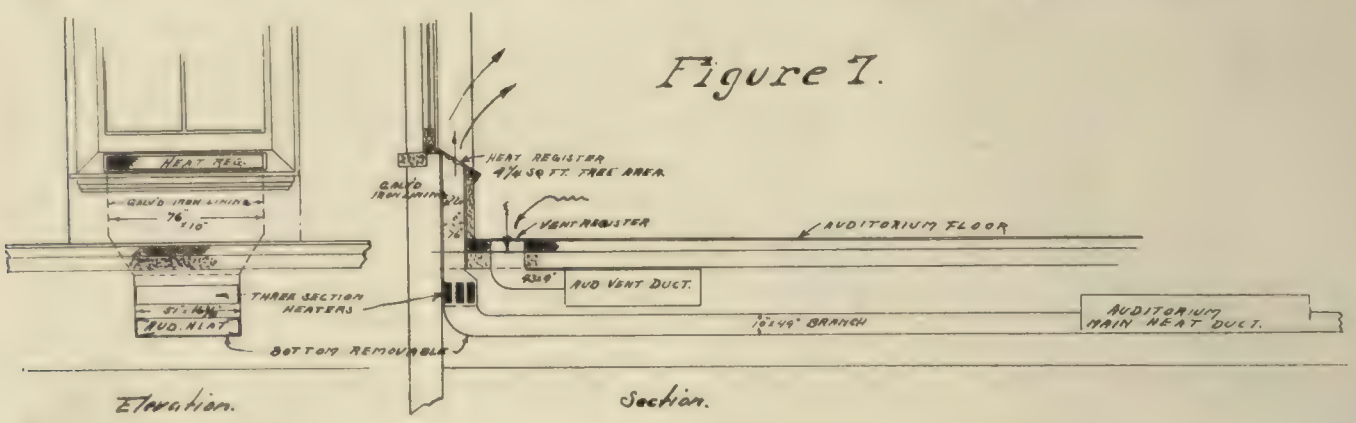


FIG. 5



heating with the back pressure valve set at 2 to 5 lbs. as may be demanded by outdoor conditions. Outside of school hours the boilers may be run under little or no pressure, as a mere vapor of steam, such as banked fires will provide, will be enough to keep a well-built building above freezing over night except in zero weather.

In this connection may be noted the great value of weather strips or double sash as well as the importance of seeing that the building construction work around door jambs and window casings is closed up air-tight. These items are often overlooked and result in failure of properly designed heating plants to give satisfaction.

In general the special problems of the large school house in congested districts, so far as relates to the heating engineer, may best be solved by mechanically providing plenty of air taken from purest available source and further purified by passage through combined air washers and humidifiers, delivering such pure, fresh air to the rooms at suitable temperatures (controlled thermostatically) and at low velocity, through ducts and flues so arranged as to give a uniform distribution throughout each room and at the same time permitting unobstructed use of floors for large rooms where needed.

THE HEATING AND VENTILATING OF INEXPENSIVE SCHOOL HOUSES—THE METUCHEN SCHOOL, NEW JERSEY

BY CHARLES MORRIS, ARCHITECT

The architect is often confronted with conditions in a small school building where cost is an important factor. The committee usually require a certain number of class and other rooms, and the appropriation may be limited. Often other conditions are imposed, such as the character of the exterior, the brick to be used, and possible additions of terra-cotta or stone courses. The question then arises, and it is a serious one, as to what portion of the appropriation can be set aside for heating and ventilation.

In large school buildings where low cost is not an object, the more elaborate systems may be employed; but in the case of a small school these expensive systems must be eliminated, especially if the other requirements are to be carried out.

Still, even in the small school there are certain conditions which must be met in order to insure to each pupil the requisite amount of fresh air. In the States of New York and New Jersey, for instance, warmed fresh air

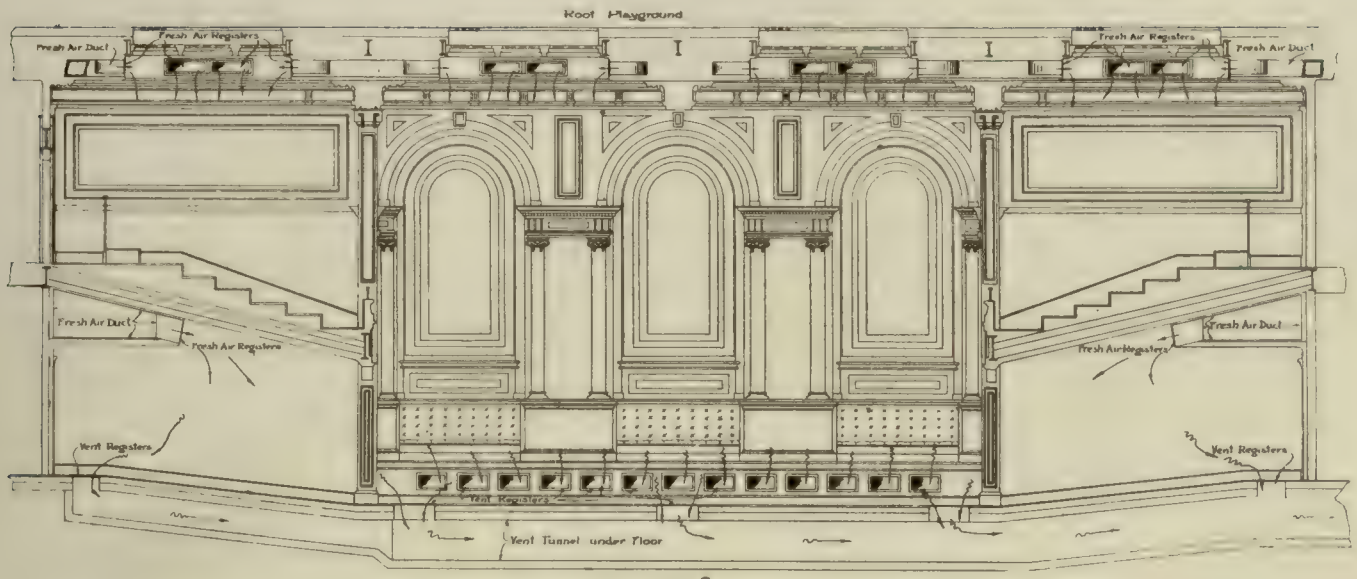


FIG. 8

must be introduced at the rate of 30 cubic feet per minute per pupil.

In the case of the Metuchen School, illustrated in this issue, where the appropriation was only $45,000, eleven class rooms, seating forty pupils each, and an auditorium seating 300 being required, the more elaborate systems could not be considered. The problem then arose to fulfill the requirements of the law and not exceed the appropriation.

This was accomplished by using a system of forced hot air, carried to the various rooms from the fresh

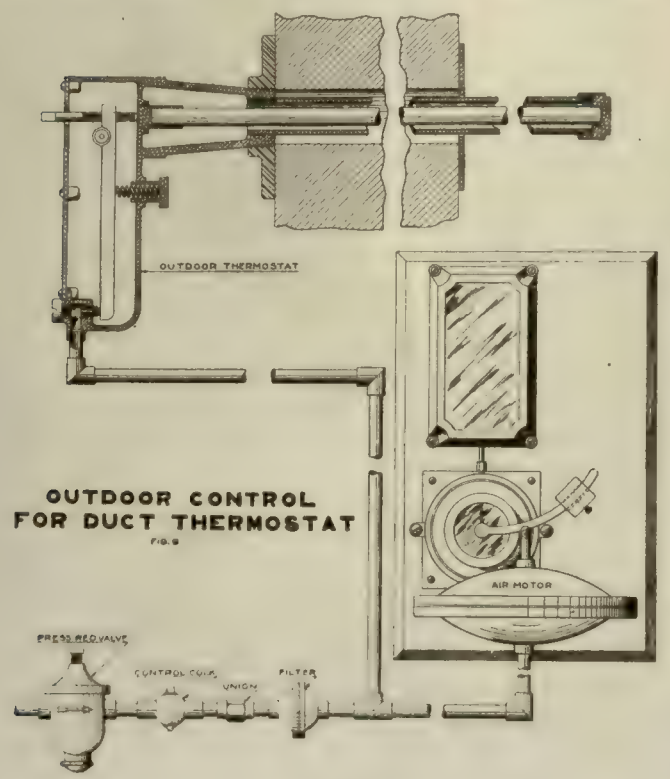


FIG. 9

air room in the basement in which was placed the fan and motor. The heat was supplied by four large hot-air furnaces. Air was furnished to the fresh-air room by a large galvanized iron duct hung from the ceiling. Hinged windows in the outside wall were connected to this for regulating the amount of air to meet the varying weather conditions.

At the warm air registers in the class rooms, placed 8 feet above the floor, there is a pulley attachment for operating damper chains; the pulley is provided with clutch for holding chain operating damper at foot of riser at any desired position. By this arrangement the temperature of the room may be lowered without affecting the amount of fresh air admitted to the rooms. This chain also operates a temperature indicator in the furnace room, informnig the engineer of the condition of all rooms without the necessity of visiting them, thus making it possible for him to regulate the supply of coal for the furnaces.

Vent registers are placed at the floor.

The ceilings over the four groups of cloak rooms on the second floor are furred down and the vent risers empty into these spaces, which in turn are connected to two large chambers on the third floor, and thence to the ventilators above the roof. This part of the system is very simple and works admirably, the principle being that the warm air forces the foul air to the vent flues and also that there is a certain amount of suction by the ventilators, which are open on four sides.

The principal's and teachers' rooms, while being provided with the same system as the above, are supplemented by hot-water radiators connected to a coil in the furnaces, so that these rooms may be heated independently of the hot-air system if desired.

The cost of the above system was $3,750, which is considerably less than a system of direct radiators using either steam or hot water, and supplying tempered fresh air to the rooms.

The cost of coal consumed the first year (which is usually in excess of the normal amount) was $423.80. Considering the fact that the cubical contents are 288,060, it is equivalent to $1.47 per thousand. Two dollars and over per thousand cubical contents is not uncommon in the other systems.

System of Ventilating Cremating Closets

This I think may be of interest to many architects erecting schools in districts where there are no sewers

and where the soil is of such a character that the use of cesspools or a system of sewage disposal are not advisable.

In this school the soil conditions were unfavorable for either cesspools or a system of sewage disposal. The soil was a thick red clay, and, to make matters worse, water was found at about a depth of four feet.

The system adopted is known as "Ventilating Cremating Closets." There are two ranges of closets, for boys and giris. Beneath these ranges are ducts connected to a flue forming part of the main stack, in which was placed a heater, called a "stack heater," which also serves the purpose of heating all water used for the wash basins and slop sinks in the building.

The fire in this stack heater is kept burning throughout the day and creates a current of air from the toilet rooms to the outer air. The height of chimney stack is five feet above the ridge of roof. At the beginning of each duct are pits called "firing pits," provided with small grates. The ducts are divided by a cast-iron dome-shaped plate, called a "drying plate," and the under portion of each closet is of iron, also the underside of closet seats. About once a month kerosene is sprinkled on the drying place in the ducts under the closet ranges and a small fire is kindled in the grate. This dries the deposit and it passes up the stack as a fine dust.

The urinals are also connected to the underground duct by a large earthenware pipe.

These toilet rooms are absolutely free from any odor and have given entire satisfaction.

The cost of installation for 15 closets, 10 urinals and stack heater was $600. Estimates received for a sewage disposal plant amounted to four times this amount, owing to the large quantity of tile required for the irrigation fields.

THE PLAYGROUND

THE NECESSITY FOR LARGER SPACE THAN IS AFFORDED BY THE USUAL SCHOOL YARD, FULLY REALIZED—ITS BENEFICIAL INFLUENCE ON THE HEALTH AND MINDS OF SCHOOL CHILDREN

It is largely in the playgrounds of our schools and colleges that the attributes that make the necessary qualifications for good citizenship are fostered. The teachers in charge of the school playgrounds and those spaces provided in large cities for the recreation of children on holidays and after school hours, are unanimous in the verdict that they are powerful factors in the mental and moral development of school children.

The American people, as a rule, take life too seriously. As children, we have never been taught how to play.

It is a healthy sign that those in charge of educational matters in this country are awakening to a true sense of the importance of recreation in the school life, and are making provisions for this in the planning of our schools.

The Playground Association of America has been organized to provide adequate playgrounds in districts where, owing to congestion of population, there would ordinarily be no space for this purpose.

Dr. Luther Halsey Gulick, president of the Playground Association of America, recently stated: "A fundamental condition for the permanent development of a free people is, that they shall in childhood learn to govern themselves—self-government is to be learned as an experience rather than taught as a theory. Hence, in a permanent democracy adequate playgrounds for all the children are a necessity."

The Craftsman, referring to the well directed activities of the Playground Association, and with special reference to conditions as existing in New York City, states: "Aside from the encouraging showing made of the rapid and effective spread of the movement as a whole, one of its most interesting features was the demonstration given of the good which has been accomplished within a very short time by one branch of its many activities. About a year ago the association succeeded in making the national and folk dances of different countries a distinct feature of the physical training of children in the public schools of New York, particularly those which are situated in the congested districts of the East Side, where the majority of the children are either foreign-born or the American-born children of foreign parents. The teachers have found that one great difficulty in the way of the training of these children for future citizenship is the racial antagonism that so often manifests itself among them. This is fostered, rather than discouraged, at home and in the streets and is often beyond control even in the schoolrooms, but it soon vanishes when all share in the dances and games at the playground. Another element of discord is the inevitable result of the newly acquired American "smartness" which makes them ashamed of the old-fashioned foreign speech and ways of their parents, and anxious to forget, as soon as possible, the customs of the old country. As the denial of loyalty to the traditions of their native land is hardly the best foundation upon which to build a sound and loyal citizenship in this country, it was considered advisable to try to keep alive in the hearts of the children a kindly memory of the land of their forefathers, as well as genuine interest and respect for the customs and speech of their parents and grandparents, by reviving the traditional games and dances that are a part of the national life of almost every people but our own."

The obsolete notion that the elemental education of the younger children should be confined simply to the "three r's" has given place to a scheme of instruction that not only includes the fundamental requisites, but aims to impart patriotism and good citizenship. While inculcating the veneration and respect in foreign-born children for the country of their adoption, it does not do so by teaching them disrespect for that of their birth. It takes them when the hours of study are past and places them in surroundings where within reasonable limits they may find recreation and exercise to help the body sustain the mental work that it is called on to endure. In fact education in this country has become so broad in its scope that it may be said to be parental in its character and today among our poorer classes of foreign population in the congested districts in our larger cities throughout the country the boy may be truly said to be the father to the man.

THE HEATING AND VENTILATING OF SCHOOL-HOUSES IN EXPOSED LOCALITIES

By CHARLES F. EVELETH, Heating and Ventilating Engineer, Schoolhouse Department, City of Boston, Boston, Mass.

IN the early days of schoolhouse design it was customary to assign certain spaces, rather indistinctly defined, to contain the heating and ventilating apparatus. The basement was often divided off into commodious toilet rooms, playrooms, corridors and storerooms; the rest of the space being reserved for the boilers, radiating surface, fuel, ashes, etc. This was often so small that the heating contractor was compelled to cut down the size of his apparatus to fit the contracted quarters, with the result that the building was insufficiently warmed, poorly ventilated, could contain but a limited supply of fuel and many parts of the apparatus were almost inaccessible for cleaning or making repairs. In extreme weather it was only by starting up the fires very early in the morning and forcing the apparatus to the utmost that the janitor was able to have the building habitable in time for the opening exercises.

The importance of installing a suitable heating and ventilating apparatus in the modern schoolhouse is now very generally recognized, on account of its relation not only to the comfort and health of the occupants, but also through their ability to accomplish better results when provided with a plentiful supply of fresh warm air. The success of any system depends in a large degree upon the proper location of the various parts of the apparatus, and it is therefore necessary, even in preparing the preliminary sketches, to make suitable provision to receive them. The room taken up by the boilers, radiating surface, fan engine, pumps, heat and vent ducts and the like, should first be approximately plotted out, after which the enclosing walls may be drawn in.

The limited extent of this article will not permit the writer to go deeply into the details, but an attempt will be made to call attention to certain fundamental points which must be kept in mind by the architect in planning the building. If these are taken into consideration at the outset much valuable time will be saved later. After a brief description of a number of systems, mention will be made of the more important features to be taken into consideration, and these will then be illustrated by an account of the heating and ventilating apparatus recently installed in two new schools located in the outlying districts of Boston.

Before allotting the space which the apparatus will require, a choice must be made of the system best adapted to the building. The low pressure gravity indirect and the plenum systems have been successfully employed. Each has its advantages and limitations, and in each the field of usefulness is quite clearly defined. In the former a stack of indirect pin radiators enclosed in galvanized iron is placed in the basement near the ceiling and at the foot of the air flue to each classroom. The stack is arranged in such a manner that the air from outside will pass between the sections and after having been heated will enter the room through the warm air flue. An opening at the base of the flue will permit the cool air to enter without being warmed. By means of a mixing damper operated by a chain under the control of the teacher the volume of cool or heated air may be varied so that the temperature of the air at the inlet to the classroom may be varied through a wide range. The fresh air flues may be so grouped that the stacks for any tier of rooms can be located in a single chamber, the cold air being admitted through hinged windows or doors. If the proper amount of radiation is installed, a sufficient quantity of air may be furnished both to warm the room and provide the requisite ventilation. The foul air is removed through vent flues carried well above the ridge of the building and provided with aspirating coils, placed just above the room outlets to raise the temperature of the outgoing air, and thus increase its velocity. The wardrobes, corridors and smaller rooms as well as the basement sanitaries and play rooms are heated either by direct radiators or coils. A steam pressure of from two to five pounds is carried in the boilers and the water of condensation is returned by gravity. The advantages of this system are the low cost of installation, minimum cost of repairs and ease of operation, requiring no skilled help. It is, of course, not as positive

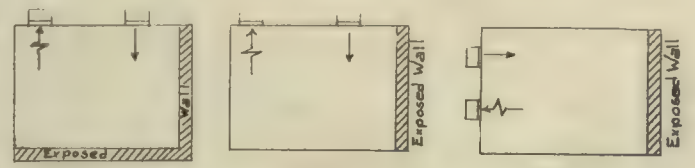


FIG. 1. FIG. 2 FIG. 3.

as the plenum system under all conditions of temperature and weather, inasmuch as the flow of air is produced by the difference in temperature between that in the flue and that outside. Care must therefore be taken to have all ducts built as nearly vertical as possible and the flues and openings made of ample size.

In the plenum system, air is forced into the room by a fan or blower driven either by a steam engine or an electric motor.

The air is first warmed to a temperature of about 68 degrees F by means of a primary heater located close to the fan. The heater may be made either of pipe coils, divided up into sections, or of cast iron indirect radiators arranged in groups. Where pipe coils are used certain sections are controlled by hand valves and the remainder are provided with diaphragm valves operated by a thermostat located in the main duct beyond the fan discharge. A most satisfactory arrangement is obtained by employing pin radiators, with mixing dampers placed above and below the sections and under the control of a thermostat placed as described above. In mild weather some of the stacks may be shut off. If the heater is so arranged that the air is drawn

FIG. 4

through the churning action of the fan blades will thoroughly mix together the hot and cold air. A supplementary heater of cast iron pin radiators is placed at the base of the hot air riser to each classroom and is provided with diaphragm valves controlled by a thermostat placed in the classroom. The temperature of the entering air may then be varied by the opening and closing of the valves. In place of the supplementary stacks the rooms may be kept at the proper temperature by groups of wall radiators or by pipe coils placed along the outside walls under the windows and controlled by thermostats.

When the fan is driven by an engine it should have a cylinder of large diameter so that the boiler pressure need not exceed twenty-five pounds. By means of a reducing valve the steam pressure on the system can be reduced to from three to five pounds and the water of condensation automatically returned to the boiler by a steam pump and receiver. By installing a back pressure valve and a suitable oil separator, the exhaust steam can be turned into the heating system, thereby making a very material saving in fuel. In case it is not desired to have the condensation mingle with that from the rest of the system on account of the presence of oil, the steam may be turned into certain sections of the primary heater, which in this case should be piped up separately and arranged to waste into the sewer.

Aspirating coils are placed in the vent flues from the classrooms in the same manner as the previous system.

In the plenum system the air supply is practically constant under nearly all conditions of outside temperature and wind action. It is, however, considerably more expensive than the gravity indirect system. The additional apparatus required, such as automatic feed pumps, fan, engine, temperature control, etc., is not only more complex but also much easier to get out of adjustment and requires a more experienced janitor to operate it.

For a building containing not more than ten or twelve classrooms, the basement being given up to sanitaries and playrooms, thus permitting the heating chambers to be conveniently located directly under the warm air flues, the gravity indirect system can be installed and yield satisfactory results. If, however, it is desired to use part of the basement for such purposes as cooking, manual training and the like, which require the same air supply and temperature regulation as regular classrooms, the plenum system is preferable for two reasons: First, the space required for the gravity chambers will badly interfere with the satisfactory planning of the rest of the basement; and, second, there is no way of providing a suitable arrangement of mixing dampers and air supply to these basement rooms, except by installing small fans or blowers.

The location of the schoolhouse should have considerable influence in the selection of the system to be installed. No difficulty will be experienced in obtaining skilled help to operate the apparatus, or making quick repairs in case of a sudden breakdown, in a city school; but if located in a thinly settled community where repair parts can not be readily obtained and a competent janitor is an uncertain proposition, the failure of some of the automatic apparatus in severe weather would entail considerable annoyance and a possible closing of the school.

The next step in the design is the location of all of the heat and vent ducts, and it is very important to have

FIG. 5

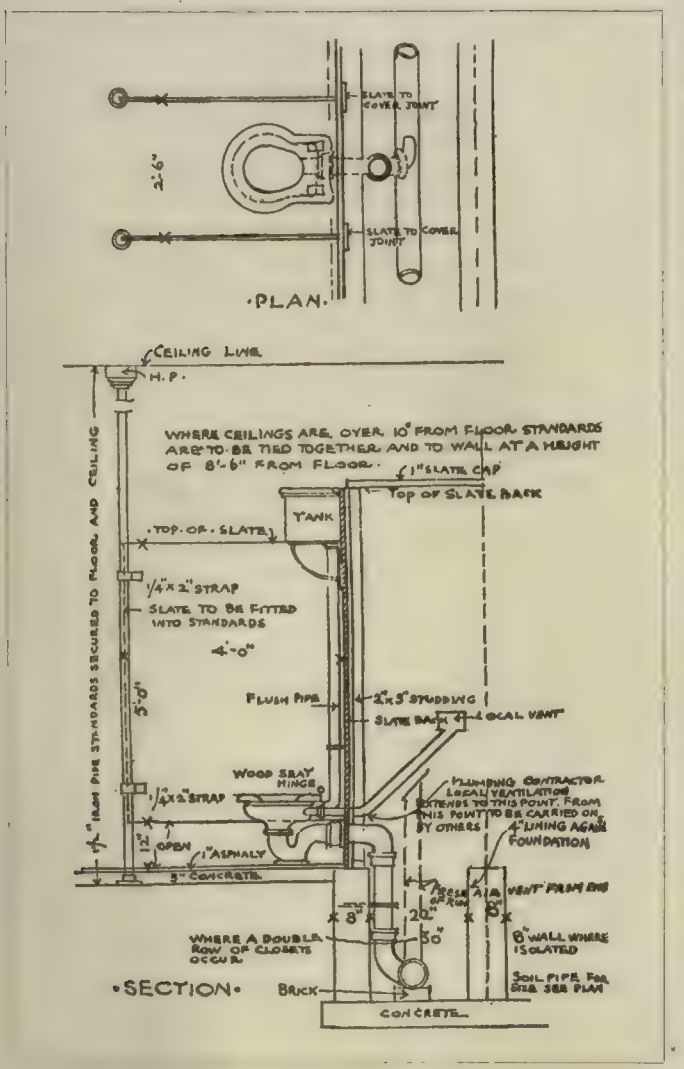


FIG. 6—SHORT HOPPER CLOSET

those for the classroom properly placed so as to obtain a thorough and complete circulation of the air and heat throughout the room. Figs. 1, 2 and 3 show satisfactory arrangements.

In each case the bottom of the heat inlet is about 8½ feet above the floor, allowing the room to be 12 feet high, and the vent outlet is at the floor.

In some instances the ducts for two sets of rooms can be grouped together. By referring to the floor plans of the Nathan Hale and Edward Everett School, the advantage of this arrangement is at once apparent. In the case of the first mentioned school it brings two sets of indirect stacks together in a single chamber. In the other school it decreases the number of branch ducts. Special care should be observed in placing the indirect stacks in the right position at the base of the air ducts. They should be located so that the warm air will pass up on the front or room side of the duct and the cold air used for mixing will pass up on the rear side. If placed in the opposite direction so that the warm air rises on the rear side of the duct, cold draughts will be felt when the mixing dampers are in certain positions.

Additional ducts should be provided for removing the foul air from the wardrobes, corridors, master's, teachers' and nurses' rooms. It is not necessary ordinarily to incur the extra expense of providing separate air supply for rooms of this character. In the accompanying drawings the door of each wardrobe which is situated farthest from the vent duct is sawed off about two inches at the bottom, thus providing an opening through which air from the classroom may pass to replace the foul air drawn out. The vent flues from the sanitaries should be carried up separately to the tops of the main ventilators. They should be so located that the horizontal runs, particularly from the fixtures in the basement, are as short as possible. One frequently finds the chimney made of heavy boiler iron and set in a rectangular brick flue, the space around the chimney being used as a toilet vent stack. Several cases have recently come under the writer's observation where the iron has been almost entirely rusted through, due probably to the action of the damp air. This method is not recommended. An aspirating coil of sufficient size placed at the base of the flue, just above the inlet, or a series of rising pipes is more satisfactory.

Vertical flues may be built either of brick, terra cotta blocks or galvanized iron. When built of masonry care must be taken to have the joints on the inside laid as smooth as possible to prevent loss by friction. Galvanized iron ducts are usually furred in with metal lath and then plastered.

The smaller vent ducts from the wardrobes, teachers' and master's rooms and the like, should be preferably of galvanized iron and may be offset in the attic space to enter the main vent outlets.

The horizontal ducts radiating from the fan, in connection with the plenum system, are usually built of galvanized iron if carried on the basement ceiling. A better method is to run them beneath the basement floor, making them of brick or concrete, and thereby permitting the height of the general basement to be reduced. Where a gravity system is to be installed the location of the heating chambers should be the first step in planning the basement. The most satisfactory arrange-

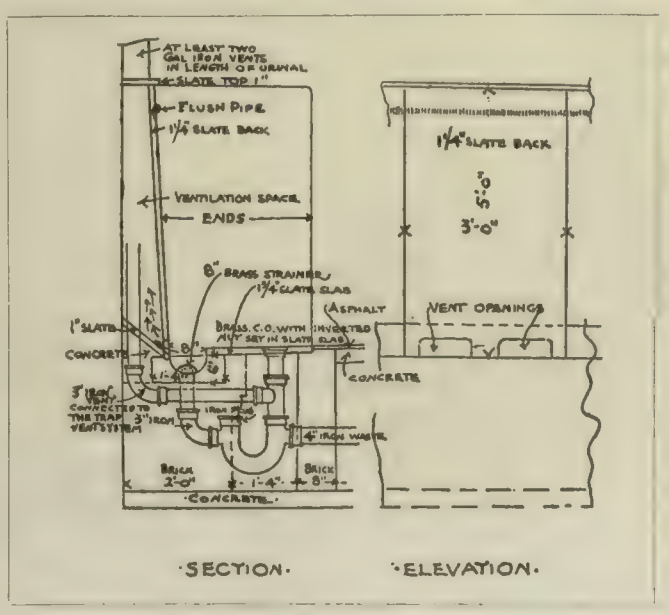


FIG. 7—SLATE URINAL

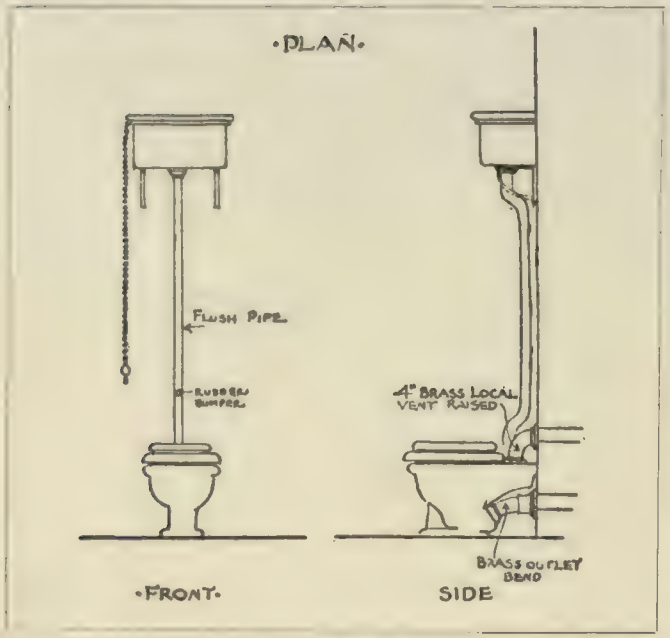


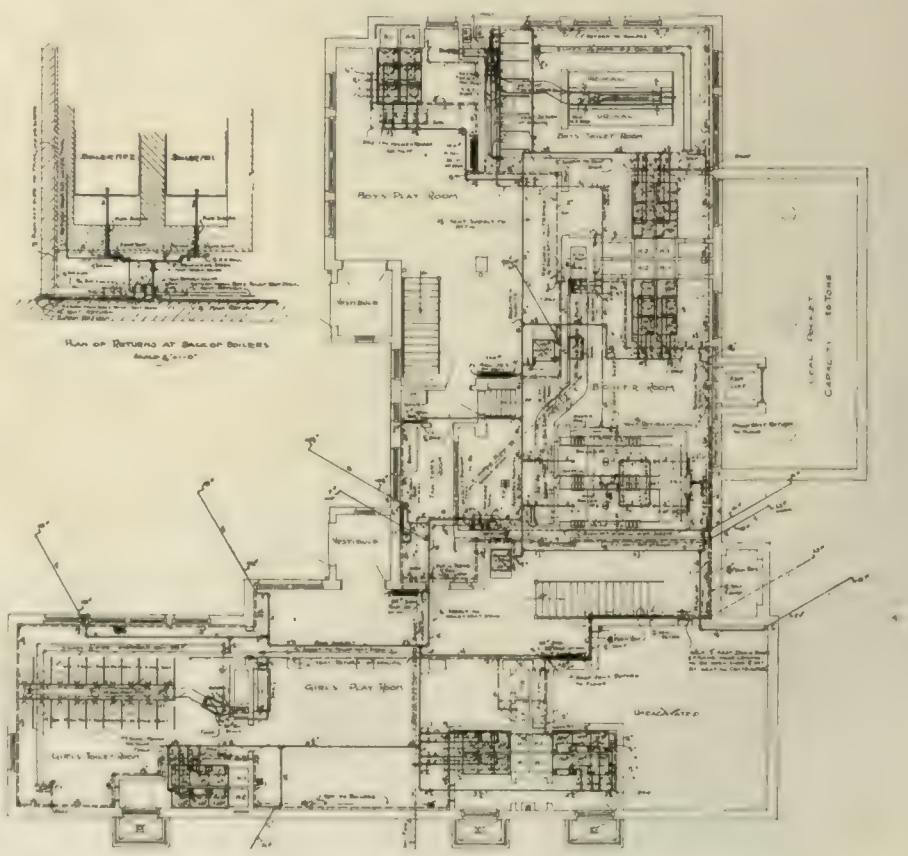
FIG. 8—TEACHERS' CLOSET

ment is to build them of brick with 8-inch-thick walls, which will also serve to support the radiators. A reference to the basement plan and detail sheet of the Nathan Hale School will give one an idea of the size and arrangement and also details of construction. The boiler room ought to be centrally located, but at the same time there must be easy access to the street for removing the ashes. A coal room adjoining the boiler room and large enough to contain a year's supply, with a driveway to permit teams to reach the chute and thus do away with the necessity of handling it with baskets, will simplify the fuel question. An allowance of ten tons of coal per classroom and 43 cu. ft. per ton will give the required contents of the room, bearing in mind that the coal cannot be piled up to the ceiling. If horizontal return tubular boilers are installed, a space in front equal to the length of the tubes is necessary in order to permit their withdrawal in case of repairs. It is well to allow a distance of four feet at the rear for piping up the return connections. A solid foundation is absolutely necessary to sustain the boilers, and an examination should always be made of the character of the soil to determine whether piling is necessary. If the ground is wet, waterproofing may be required. The height of the boiler room will depend upon the size of the boilers and may range from fourteen to seventeen feet in the clear. The determining factor is the distance between the water line of the boiler and the bottom of the lowest stack of radiators, which, in a gravity system, should be at least three feet, and preferably more.

Avoid placing the boilers or any of the other apparatus in a poorly lighted place. Provide plenty of windows to give air and light, and encourage the janitor to keep the premises clean. The most satisfactory floor for both the boiler and coal room is made of paving brick laid on edge and grouted. A floor drain will enable the fireman to keep things tidy with the least amount of effort.

By exercising some ingenuity the fan and engine room may be located close to the boiler rooms. Plenty of space should be allowed in front of the engine cylinders so that the head may be taken off and the piston withdrawn. If the engine is belted to the fan, keep the belt centers at least ten feet apart.

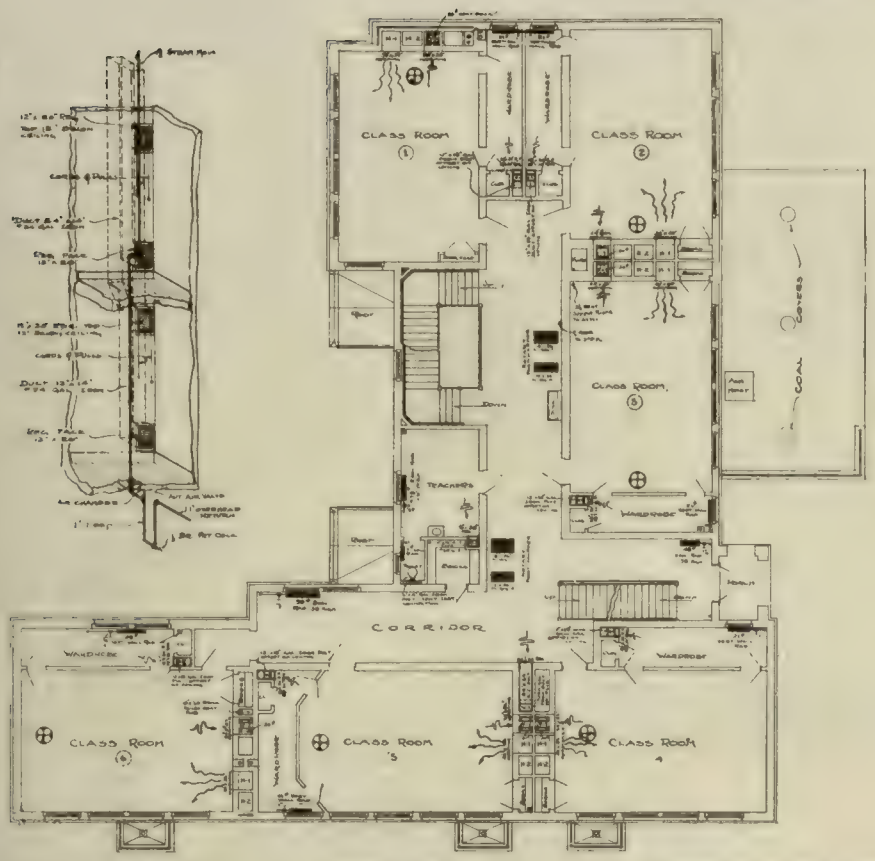
The schoolhouse being ordinarily symmetrical, it is well to place the fan so that the discharge will lie along the axis of the building and thus deliver an equal quantity of air in either direction. The primary chamber, which naturally adjoins the fan room, ought to have the fresh air inlet so located that dust, leaves, etc., cannot be drawn in. It is preferable to have the intake over a grass plot, and at the rear of the building, to avoid the dusty street. In thickly settled localities it may be necessary to construct a shaft to take the air from a point well above the ground. In such a case the architect will, of course, avoid placing it near the toilet vent outlets or the chimney. By providing doors in the wall of the primary chambers below the heater, air may be taken from the basement in the morning, thus permit-



BASEMENT PLAN

NATHAN HALE SCHOOL
BOSTON, MASS.

PARKER, THOMAS & RICE
ARCHITECTS



NATHAN HALE SCHOOL
BOSTON, MASS.

FIRST FLOOR PLAN

PARKER, THOMAS & RICE
ARCHITECTS

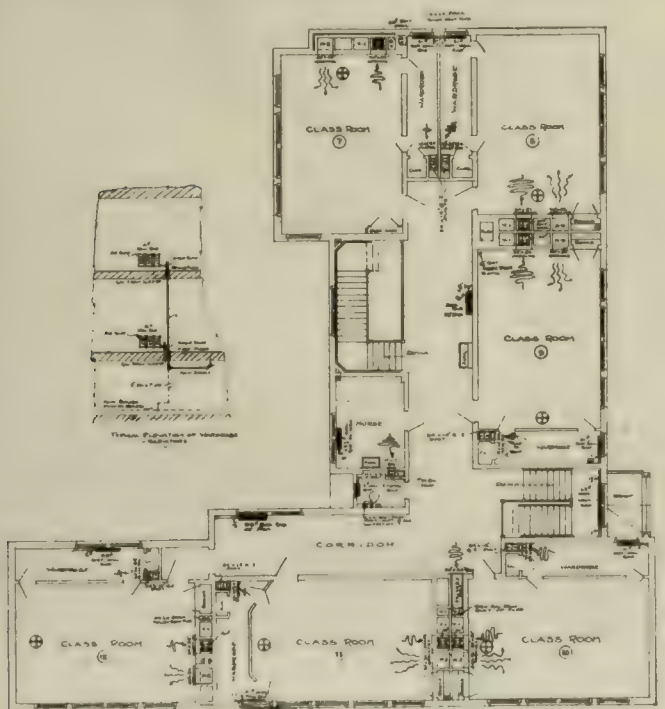
ting the school building to be heated to the proper temperature without too much loss of time.

Description of the Heating and Ventilating Apparatus in the Nathan Hale School.

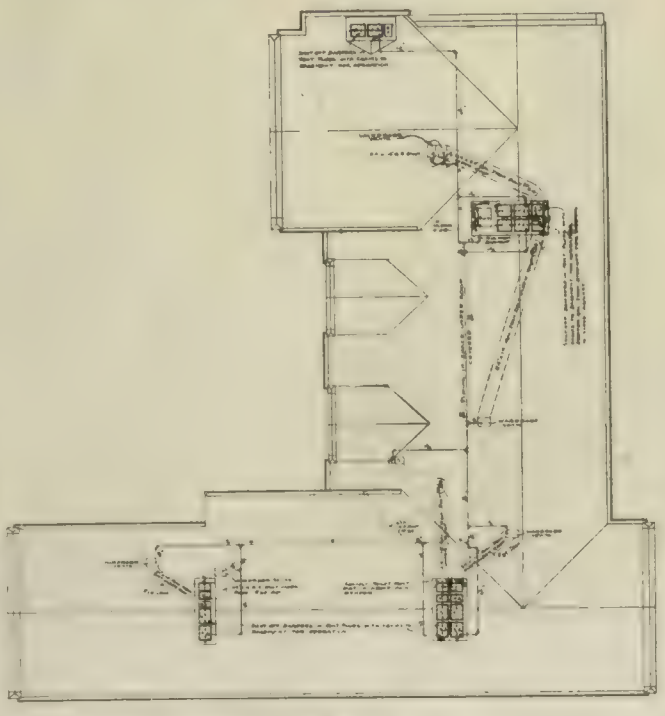
The Nathan Hale School, situated on Cedar Street, Roxbury, is a lower elementary school containing twelve classrooms, and is of fireproof construction throughout. The architects of the building were Parker, Thomas & Rice, of Boston. The heating and ventilating apparatus was designed by the Schoolhouse Department under the direction of the writer. On account of the size of the building and the fact that there were no classrooms in the basement, a low pressure gravity return heating system was installed.

There are two horizontal return tubular boilers each 54 inches in diameter, 15 feet 3 inches long and containing 60 charcoal iron tubes 3 inches in diameter and 14 feet long. The heating surface is approximately 749 square feet for each boiler. Shaking grates were furnished, each having an area of 22½ square feet. A damper regulator is provided to maintain a steam pressure of from 2 to 5 pounds on the system, although circulation will take place even when no pressure is shown on the gauge. The safety valves conform to the requirements of the Massachusetts District Police, and are set to blow at 15 pounds pressure.

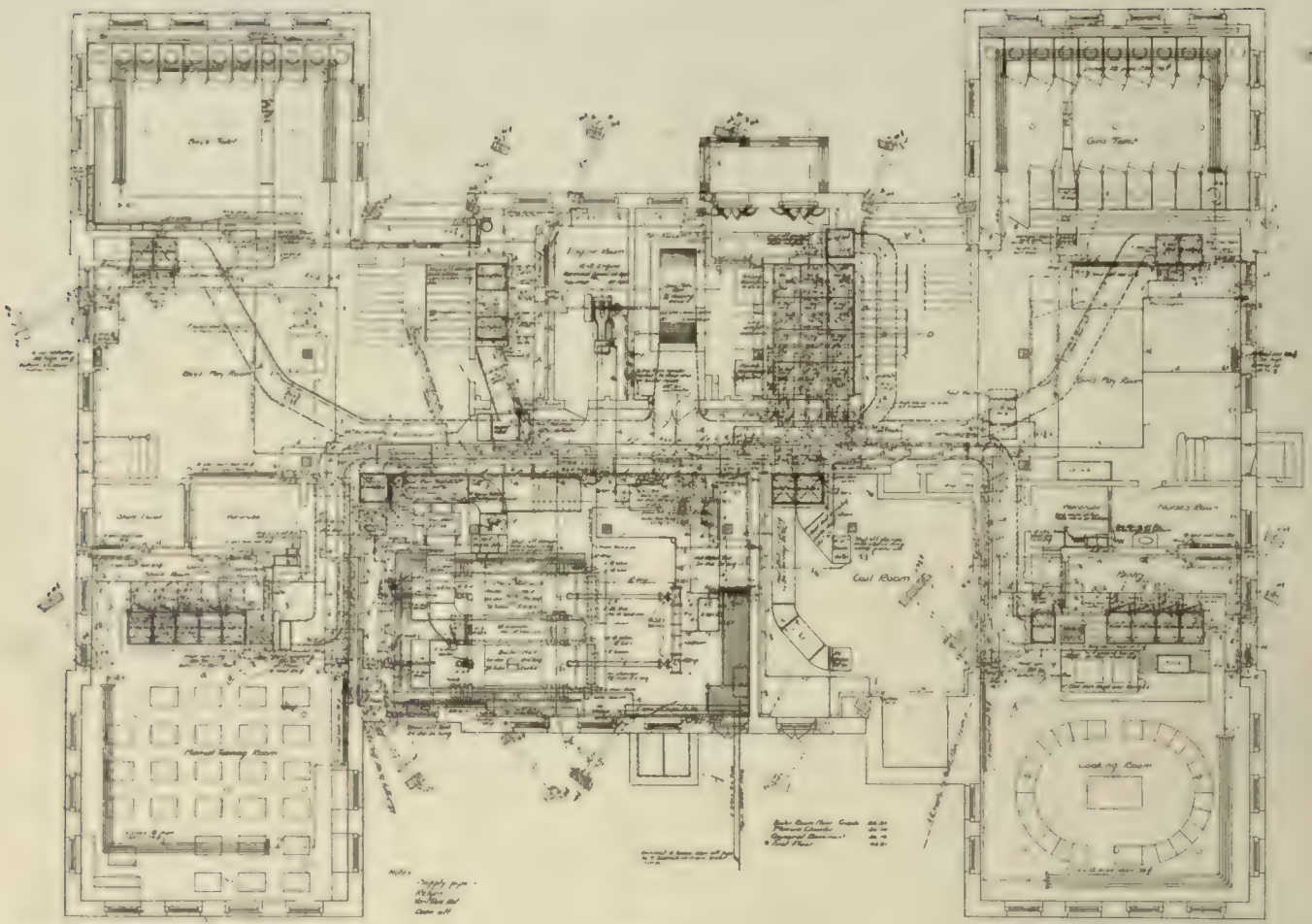
A hot water tank is installed near the front of the boilers, having a capacity of 95 gallons and containing a brass pipe coil under the control of an automatic tank regulator.



SECOND FLOOR PLAN
NATHAN HALE SCHOOL, BOSTON, MASS.



ROOF PLAN
MESSRS. PARKER, THOMAS & RICE, ARCHITECTS



EDWARD EVERETT SCHOOL
BOSTON, MASS.

BASEMENT PLAN

MR. EDW. T. P. GRAHAM
ARCHITECT

The radiation is as follows:

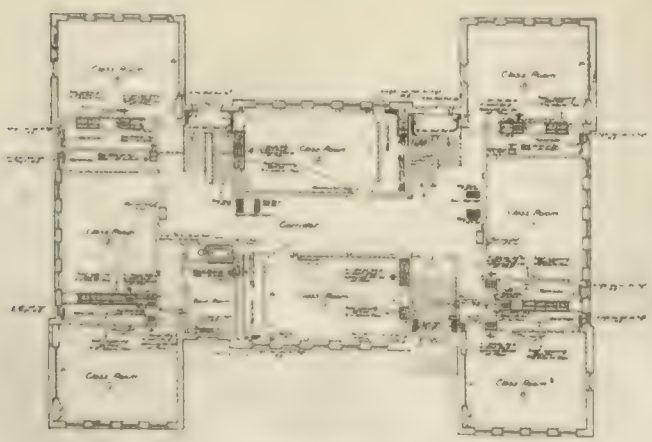
Pipe coils	179	square	feet
Vent flue surface	280	"	"
Direct radiators	1166⅓	"	"
Indirect radiators	4800	"	"
Foot warmer radiators	240	"	"
Total	6665⅓	"	"

In the vent flue from each classroom is placed a radiator containing 20 square feet. Each wardrobe vent has a riser of 1½-inch pipe.

The vent duct from each basement toilet room is provided with an aspirating coil having 20 square feet.

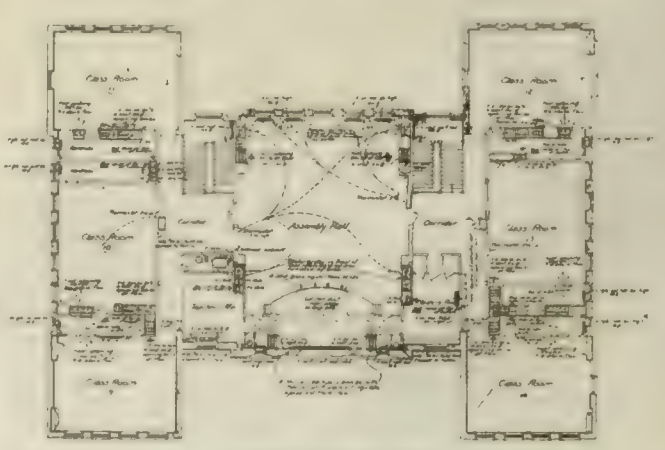
The classrooms are all heated by indirect radiators placed in brick chambers in the basement. A cast-iron door opening into the basement is furnished for each chamber, to be used for night circulation when the fresh air windows are closed.

Classrooms with one exposure each have 360 square feet of radiation; those with two exposures having 420 square feet. The stack for each room is divided into three sections. In the first floor corridor are two foot warmers, each containing 120 square feet of indirect radiators, suspended from the basement ceiling and en-



FIRST FLOOR PLAN

EDWARD EVERETT SCHOOL.

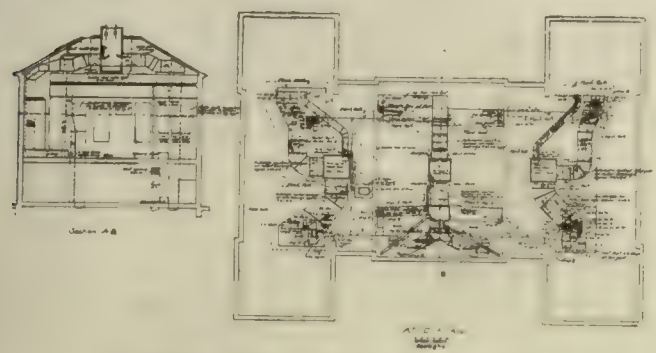


SECOND FLOOR PLAN

BOSTON, MASS.

closed in galvanized iron. They are arranged as shown in the detail drawing.

The piping system is laid out in such a manner that all of the aspirating coils except those for the sanitaries may be closed off. This is for use in extreme weather and at night.



EDWARD EVERETT SCHOOL, BOSTON, MASS.

All piping in the basement and attic as well as the risers and also the smoke flue and hot water tank are covered.

The classrooms are each 30 feet long, 20 feet wide, 12 feet high and contain 43 occupants.

The system is designed to provide 30 cubic feet of air per minute to each occupant, and the air supply to each classroom is therefore approximately 1,300 cubic feet per minute. The heat and vent flues to the classrooms and the vertical vent flues from the sanitaries and corridors are built of brick. The vent ducts from the wardrobes, teachers' room and nurses' room are galvanized iron, and crossing overhead in the attic space enter the brick ventilators. The heat ducts are 24 inches by 32 inches and the openings into the classrooms 30 inches by 36 inches. The vent ducts from the classrooms are each 24 inches by 30 inches and from the wardrobes 12 inches by 14 inches. The typical sections through the heat chambers and flues clearly indicate the method of controlling the volume of air to and from the rooms. The dampers in the bottom of the stack casings regulate the air supply to the stacks, and the volume dampers in the vent ducts can be adjusted to obtain the required outflow. For closing the system at night there are large dampers in the main vent ducts operated by chains extending to the basement.

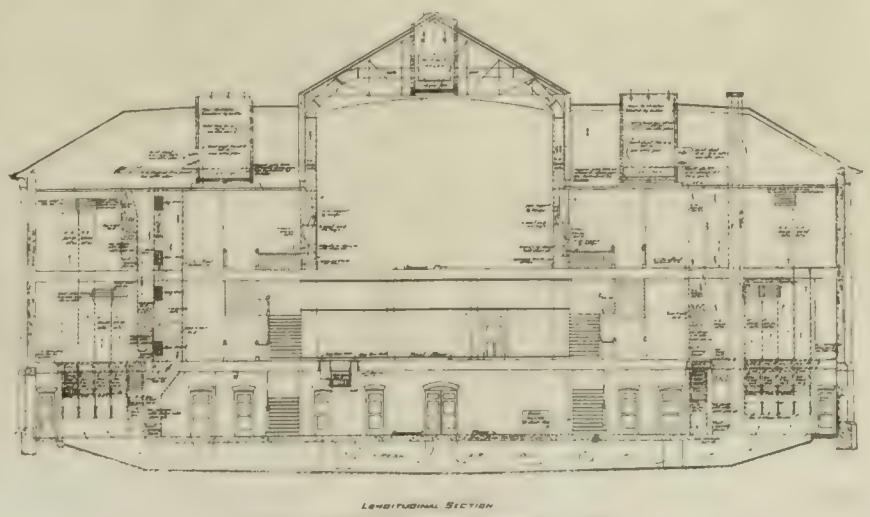
No guards or registers are placed over the heat and vent openings in the classrooms. At each vent opening the floor and baseboard are carried into the back side of the duct and the presence of any dirt is at once apparent. The heat openings have horizontal deflectors made of galvanized iron and painted to match the walls of the room. These openings are shown in Fig. 4 and Fig. 5.

A separate system of toilet vent ducts is run from the fixture to the top of the building. The water closets in the basement sanitaries are of the short hopper type, each having at the back an outlet 10 square inches in area. These openings are connected together by galvanized iron ducts which are increased in size so as to be equal to the area of the branches, as shown in Fig. 6. From the space back of the urinal slabs branch ducts are run as shown in Fig. 7, with an allowance of 8 square inches of duct area for each lineal foot of slab. In Fig. 8 is shown the method of ventilating the individual closets. Shut-off dampers are placed in the main ducts, which may be closed at night in extreme weather.

Description of the Heating and Ventilating Apparatus in the Edward Everett School

The Edward Everett School, which is located on Pleasant Street, Dorchester, is an upper elementary school, having fourteen classrooms and an assembly hall. There is also in the basement a cooking room and a room devoted to manual training. This building is also of fireproof construction. The classrooms are each 29 feet long, 23 feet wide, 12 feet 6 inches high, and it will seat 44 pupils. The general basement was originally planned to be 10 feet 6 inches high in the clear and the boiler and coal rooms 16 feet high. These dimensions were later reduced 6 inches. Mr. E. T. P. Graham, of Boston, was the architect of the building, and the heating and ventilating plans were prepared by the Schoolhouse Department.

A plenum system was installed for the reason mentioned earlier in the article for a building of this character. The two horizontal return tubular boilers are each 60 inches in diameter, 17 feet 4 inches long and contain 72 charcoal iron tubes 3 inches in diameter and 16 feet long. The heating surface of each boiler is about 1,012 square feet. The shaking grates each contain an area of 27½ square feet and are arranged to burn soft coal. A brass interval feed pipe is provided for each boiler, and there are two manholes, one in the top of the shell and the other in the front head under the tubes. The safety valves are set to blow at 40 pounds pressure. Fire tools, machinists' tools and a brass oiler set are supplied for the engineer. A damper regulator and a hot water tank are furnished as in the Nathan Hale School. There is also a small hot water heater for use when the large boilers are not in operation, as it is necessary to have a supply of hot water for the nurse's room during the entire season.



LONGITUDINAL SECTION

EDWARD EVERETT SCHOOL, BOSTON, MASS.

A steam pressure of 25 pounds is carried in the boilers to operate the engine and pumps. This is reduced from 2 to 5 pounds for the heating system, which also receives the exhaust steam from the engine. An oil separator and a back pressure valve are installed, and provision is made for the engine to exhaust directly into the atmosphere whenever necessary. While the engine is running the condensation from the entire system is returned to a closed tank in the boiler room, and by means of a float valve it is automatically delivered to the boilers by feed pumps which are arranged in duplicate. There is also a gravity return connection to the boilers for use at night and whenever the engine is not being run.

Fresh air is taken into the building at the rear and is drawn through a primary heater consisting of drum pin indirect radiator sections connected in groups. The temperature of the air is controlled by mixing dampers operated by a thermostat in the main duct. An 8-foot, three-quarter housing, steel plate fan direct connected to a 12-inch by 8-inch low pressure center crank engine, delivers the air to a series of underground ducts, built of concrete, which supply the vertical risers to the various rooms. A supplementary heater enclosed in galvanized iron and suspended from the basement ceiling is placed in each fresh air riser and is under the control of a thermostat in the room. The assembly hall is warmed and ventilated in a similar manner and, in addition, has direct radiators placed under the windows and connected to additional thermostats. When not in use the air supply is shut off by dampers and the room kept at the proper temperature by the direct radiators. The foul air is withdrawn from the rooms through vent ducts which run to the attic space and gather into three main ventilators that extend above the roof. No hoods are provided over the tops to keep out the weather, there being instead a copper pan 12 inches deep located at the base of each ventilator, as shown on the cross sectional drawing, and provided with a drain, connecting with the conductor system. Adjustable deflectors are placed in the air ducts wherever branches are taken off. There is a volume damper at the base of each fresh air riser that is set so as to intercept the proper quantity of air for the room. The vent flue from each classroom and those from the assembly hall have volume dampers similar to the arrangement at the Nathan Hale School, which are adjusted to allow the passage of the proper quantity of air.

Large dampers are placed in the main vent ducts in the attic space and connected to diaphragms operated by air pressure from the automatic temperature regulating system, and controlled by brass cocks on a switchboard in the boiler room. This permits the building to be closed up tight at night. Aspirating coils are placed in all vent ducts as in the school previously described.

On the basis of 45 occupants in each classroom and 52 in each of the two basement rooms, and allowing 30 cubic feet of air per minute for each occupant, there will be required for ventilation an air supply of 22,020 cubic feet per minute. At a speed of 105 revolutions the fan will furnish 22,400 cubic feet of air per minute. When the assembly hall is in use the speed of the fan is increased to 127 revolutions.

All of the air ducts, with the exception of those which are below the basement floor, are made of galvanized iron. Provisions were made when laying out the steel framing to have spaces left to receive them. By referring to the cost schedule it will be seen that the sheet metal work represents a considerable part of the total cost. In the buildings which have been recently designed it is proposed wherever possible to have the ducts built of masonry instead of metal.

The radiation was installed in accordance with the following schedule:

Pipe coils	376	square	feet
Vent flue radiators	480	"	"
Direct radiators	1870½	"	"
Supplementary radiators	2640	"	"
Primary radiators	1920	"	"
Foot warmer radiators	240	"	"
Total	7526½	"	"

The primary stack is made of drum pin indirect radiators arranged in groups. The supplementary radiators consist of the regular indirect pin radiator sections.

As stated above, the temperature of the classrooms is controlled by automatic heat regulation. Two air pumps are installed, one driven by steam and one by water pressure, to prevent shutting down the system in the case of the failure of either pump.

By referring to the drawings it will be seen that provision has been made to receive a year's supply of coal. The ashes are easily removed by an iron crane fitted with a rope hoist, and there is but a short haul to the sidewalk.

The contract price for installing the apparatus in the Nathan Hale School was $6,667, which was made up of the following items:

Boilers, castings and grates	$1,230
Boiler setting	600
Boiler trimmings	70
Tools, coal wagon, hose, etc.	91
Damper regulator	40
Hot water tank and regulator	115
Thermometers	15
Blowoff tank	40
Paper burner	55
Indirect radiators	825
Direct radiators	230
Vent flue radiators	70
Pipe coils	46
Radiator valves and air valves	100
Gate valves	225
Brass pipe and fittings	75
Iron pipe fittings	500
Iron beams and hangers	100
Galvanized iron work and smoke pipe	1,150
Pipe covering	375
Painting and bronzing	30
Labor and car fares	625
Freight and cartage	60
Total	6,667

The apparatus in the Edward Everett School cost $15,542, according to the following schedule:

Boiler castings and grates	$1,900
Boiler setting	900
Boiler trimmings	70
Tools, coal wagon, hose, etc.	110
Damper regulator	50
Hot water tank and coil	105
Thermometers	21
Blowoff tank	40
Paper burner	80
Indirect radiators	1,100
Direct radiators	400
Vent flue radiators	150

Pipe coils	150
Radiator valves and air valves	215
Gate valves	600
Brass pipe and fittings	150
Iron pipe and fittings	1,246
Extra gauges	80
Receiving tanks, pumps and governor	400
Iron beams and hangers	150
Galvanized iron work and smoke pipe	3,400
Painting and bronzing	60
Pipe covering	800
Labor and car fares	1,125
Reducing valve, back pressure valve and water relieve valve and steam trap	45
Oil separator and exhaust head	70
Fan and engine	750
Automatic temperature control	1,300
Cartage	75
Total	$15,542

Calling the assembly hall in the Edward Everett School equivalent to two classrooms and including the manual training room and cooking room we have an 18-room building. The comparative cost of the apparatus in the two schoolhouses is as follows:

Name of school.	Sq. ft. of radiation.	No. of class-rooms.	Cost per class-room.	Cost per sq. ft. of radiation.
Nathan Hale	6,665⅓	12	$555.60	$1.00
Edward Everett	7,526½	18	863.44	2.07

SANITATION OF THE MODERN SCHOOL BUILDING

By LEO H. PLEINS

In this age of progress, improvement in material entering into the construction of buildings is of such common occurrence that few, indeed, pause for a moment to consider the extent of the improvements that have been made in any special line, compared with what existed but a few years ago.

The assertion has been made, and its accuracy appears probable, that no class of material entering into the construction of buildings has been more improved or brought to a higher standard than sanitary plumbing. That there was great room for improvement in plumbing appliances is true, but it is also true that as great energy, skill and the scientific application thereof has been expended in this most important branch for real improvement as in any other direction that could be indicated.

This statement being correct, let us devote a little time to consider where this improvement is especially noticeable, and for such illustrative purpose we can take no better example than the modern sanitation of our public school buildings.

It is but a few years since the feeling became general throughout the country that the sanitary conditions of schools needed immediate attention and radical changes. Frequent epidemics, traceable to unsanitary, malodorous toilet rooms, were recorded and conditions found due to fouled and inoperative range closet systems of both the dry heated air and water-flushed type. That changes must be effected at once, if the lives of our children were not to be placed in jeopardy, was recognized by school boards, architects and engineers, and it was due to their united efforts, combined with the skill and intelligence of the leading manufacturers of sanitary appliances of the country, that the remarkable advancement existing to-day was brought about.

The first step recognized as absolutely necessary was the abolition of the range closet system and the adoption of an individual type water-flushed fixture of proper form and construction. Then began the evolution of the individual type and a practical advancement from closets technically known as hopper and trap, combined hopper and trap, to the siphon jet and combined hopper and trap with jet action type. The two latter types, known as washdown with jet and siphon jet, are the ones used to-day, and of these we will particularly speak.

The first individual closets were equipped with cisterns or flushing tanks operated by hand pull, or an automatic flushing tank operating at set intervals. It soon became apparent that it was necessary to provide some other method of flushing the fixtures; the hand pull was not satisfactory, owing to the forgetfulness of

HIGH SCHOOL, ORANGE, N. J. MESSRS. HALE & ROGERS, ARCHITECTS

SCHOOL AT POMFRET, CONN. MR. ERNEST FLAGG, ARCHITECT

children; the automatic flushing at set intervals was not sanitary unless the flushing was practically continuous, and this meant a great waste of water, the conservation of which is such an important item. This brought about the introduction of what was known as the "chain," and subsequently the "rod-acting, seat-operating" device, by means of which the flushing was accomplished when the seat was depressed, which action caused a chain or a rod attached to the rear of the seat to operate the flushing device of the cistern. It required only a short time to prove that the rod action was not satisfactory from a mechanical standpoint, as greater durability and simplicity than that possessed by this device was required. The principle of flushing the fixture by means of depressing the seat was found most satisfactory, however, and this was one of the causes for the production of an automatic seat-operating valve closet which met the requirements of school and public work most fully in every respect. The general adoption of this method of flushing proved its value as an effective and thorough flushing device and most economical in the consumption of water, an important item, and one which until recently did not receive the consideration it deserved.

Along with the improvements in closet and methods of flushing came the provision for ventilating closet bowls above the water line. Various types resulted, but it was found that vents 2 inches in diameter, the size first used, were too small, as they became clogged. The construction of bowls was therefore modified to permit vents of 3 inches diameter and over being constructed. Such fixtures are in use to-day. The objections found in regard to the 2-inch vents have been reduced somewhat by increasing the size. Still, experience has proved that unless such vents are connected to an extraordinarily efficient exhaust vent system, the method is not satisfactory, the danger being that if the exhaust be too strong, it will cause drafts; or, if not strong enough, it will fail to ventilate, with the possibility in either case of openings of vents in bowls becoming fouled unless frequently cleaned. This is not always possible on account of an insufficient number of attendants, or again, carelessness on their part may account for unsatisfactory results.

That the ventilation of closet bowls and toilet rooms is absolutely necessary is an unquestioned fact, and the proper ventilation of closet bowls and toilet rooms can best be obtained by providing each closet stall with a ventilator of sufficient area placed a few inches above the bowl that will remove both local odors and ventilate the room as well, instead of confining such ventilation to closet bowls only—this, especially, where an exhaust fan ventilating system does not enter into the scheme of the building.

Bringing the closet question down to the present time, we have, therefore, to deal with either the washdown bowl with jet action, or siphon jet type provided with a durable, simple, automatic seat-operating valve device, as the best adapted to modern sanitary work. Of the two types, the siphon jet is to be preferred unquestionably, but where cost is a vital point to be considered, the washdown bowl with jet may be substituted with the assurance of fairly satisfactory results. The main points to be considered in the selection of closets are that they be constructed of absolutely non-absorbent

materials; walls as heavy as possible; waterway not less than 2½ inches full diameter, and not reduced in area at any point. The water surface in the bowls should be as large as possible in order to reduce the fouling surface in the bowl to a minimum, and it is for this very reason that the siphon jet bowl is so greatly superior to the washdown type. The depth of seal should not be less than 2¾ inches. The flushing rim should be oval and heavily rolled and the perforations so graduated in size that the flushing of bowl is as uniform as possible at the moment the flush takes place. All attachments to bowl, such as seat, hinges, valves, etc., should be made as strong as possible and not complicated, and the bowls must not exceed 14 inches in height. An excellent method to follow in specifications is to give the weight of bowls, size of waterway, area of water surface, depth of seal, weight of trimmings, etc., and provide a clause requiring that all vitreous earthenware be of the best hard-fired sanitary vitreous china, stamped with the trade-name of the manufacturer under the glaze, and the ware guaranteed against crazing or discoloration.

Thus briefly concluding the main desirable feature of closet bowls, let us consider their proper grouping in the toilet rooms. Closet stalls may be of wood, slate or marble to suit conditions. Slate makes an excellent and inexpensive sanitary material. In any event, whatever material is used, the arrangement may be the same. Wherever possible, and we believe this will be in every case, the closet stalls should be arranged in a double battery. If conditions prevent, the stalls may be arranged in single row or battery. In either case, the stalls should be provided with a 24-inch working space behind backs, in which all tanks, flushing pipes, water-supply pipes, soil and vent pipes may be concealed. At one end of working space, a door must be provided so as to allow of admittance for inspection or repair. If closets with local vented bowls or closet-stall ventilators are used, the working space will also serve the purpose of a vent chamber by capping the top of same. The connection to main vent ducts may be taken from top, bottom or rear of vent chamber as desired. The closet stall partitions should be kept 12 inches above floor at the bottom and from 5 feet 6 inches to 6 feet above floor at top; backs of stalls should extend to floor, especially if working space is used as a vent chamber.

Whether stalls should have doors or not is an open question. The tendency at the present time in many localities is to omit the same. Where this is done the stalls need not exceed 3 feet 6 inches in depth, otherwise 4 feet 6 inches is the minimum. Doors, if used, should swing in and be so adjusted as to be open when stall is unoccupied. Stalls should be 30 inches wide on centers where possible, 28 inches is the least width permissible.

The next important fixture to consider is the urinal, which from a sanitary standpoint requires most careful construction. It is unnecessary to mention the various styles of these that have been used in the past, but instead consider the types of the present time. The essential features that a sanitary urinal must possess are that the exposed surface must be thoroughly flushed as frequently as possible and a body of water maintained to reduce offensive odors to the lowest degree; furthermore, the fixtures must not be too wasteful in consumption of water and, above all, the fixtures must be ventilated efficiently.

It is regrettable that the most common type of urinal used in schools to-day does not possess these requirements, being nothing more than a slate or marble slab with a galvanized iron gutter. The flushing is ordinarily accomplished by means of a perforated brass washdown pipe. In order for such a device to be effective too much water is consumed, and the absence of proper ventilation makes it offensive in the extreme.

A superior fixture is an urinal constructed of selected black slate and of the ventilating type with a deep solid porcelain gutter, carrying a standing body of water of not less than 2 inches in depth, which is periodically flushed out by an automatic siphon trap. The flushing of the surface of backs is accomplished by means of a controllable overflow flushing device not liable to become clogged so as to distribute the water unevenly over the surface of backs. The bottom of backs is set above the water-line in gutter and kept about an inch from back edge of gutter forming a continuous vent opening and thus ventilating the fixture as well as the room in which it is placed. The floor slab should be countersunk and grooved to drain into the gutter. Such a fixture is not expensive and will be found entirely satisfactory. Frequently a fixture as described is made up of Carrara glass instead of slate which naturally makes it more expensive.

Recently a new and most sanitary type of urinal has been introduced into school work. It is an urinal of solid white glazed porcelain, 18 inches or 24 inches in width, 42 inches to 50 inches high with a projecting lipped bottom, sides, back and top all in one piece, glazed on all exposed surfaces excepting backs and having integrant shields projecting about 4 inches from face of urinal, thus forming partitions. These urinals

SCHOOL AT BRIAR CLIFF MANOR, N. Y.

MR. H. VAN BUREN MAGONIGLE, ARCHITECT

are set together, sides being ground if required. The bases are let into floor and provided with slate, marble or porcelain floor slabs. Each urinal has a nickel-plated brass spray flushing device or integral flushing rim which distributes the water evenly over the curved surface, and the base of each urinal has a brass strainer and plug and is connected to a 2-inch P-trap set into or below the floor. The flushing is accomplished by means of an automatic tank, set to operate as frequently as desired. Each urinal has a vent opening covered by a porcelain shield of 12 square inches area near the bottom so that perfect ventilation of the fixture is assured. There is no question but what this fixture is the best and most sanitary at the present time.

Standard siphon jet or similar styles of vitreous earthenware urinal are not adapted for school work. Toilet rooms should have floor drains and traps with not less than 3-inch waste outlets with both solid and perforated covers.

Among the most important fixtures in school work are drinking fountains, and these must, of course, be sanitary. The old-style faucet and trough with germ-ladened cup has been tabooed, and the present day demands a fountain which cannot become infected and transmit disease. For this reason the pedestal fountain with porcelain bowl and metal bubbling cup was designed. This has a constantly running stream of water and makes drinking possible without the lips coming in contact with the cup. If they did they could not become infected, as the cup is constantly being washed with clean water. Some objection to the metal cups was found on account of corrosion and discoloration where the water contained iron or sulphur. Another objection was made on account of the tendency of mischievously inclined children to push those in the act of drinking and thus cause injuries to lips and teeth coming in contact with the edges of the metal cup. Improvements have lately been made in these cups by making them of vitreous china with rolled and rounded edges.

This type of fountain appears to be the best. They may be placed in corridors or playrooms, and one fountain of this type will serve many more than one where cups or glasses are used. These fountains may be provided with self-closing faucets in order to be less wasteful of water, the faucet having a small opening in order to allow just enough water to run continuously to properly wash the edges of cups.

Other styles of fountains are those with which glasses are used, and of these there are numerous types. Some are recessed into walls of corridors or provided with projecting slabs and backs. The latter are often equipped with bubbling cup.

The remaining fixtures required in the equipment of schools are lavatories and slop sinks. The former should be of non-absorbent material, with slabs with or without backs, set singly or in batteries as conditions may demand. They should be provided with self-closing faucets of a durable type. Basins should have some approved type of pop-up waste instead of chain and rubber stoppers. The wastes and supplies should run to wall instead of floors wherever possible, and the lavatories be supported on concealed wall hangers or wall brackets, as such an arrangement prevents the accumulation of dirt underneath the fixtures. Each basin should be provided with a liquid soap dispensing device which is much more sanitary than the cake soap.

As a rule, cold water only is provided for lavatories. It is needless to say that a hot-water supply should be included in the equipment, especially if the school has a gymnasium where showers are necessary.

Janitors' slop sinks may be of porcelain, enameled iron or solid porcelain with integral backs or roll rim all around as desired; sinks must be supplied with hot and cold water.

Showers for gymnasiums should have stalls and dressing compartments of slate or marble, with doors to dressing stall and duck curtains protecting openings between showers and dressing stalls. The shower stalls should not be less than 3 feet x 3 feet inside and dressing stalls 3 feet x 2 feet 6 inches. The shower stall should have a porcelain or slate or marble countersunk floor slab with combined floor drain and trap in center with 2-inch waste. The opening between shower and dressing room should have a coping of slate or marble 6 inches high to prevent water from splashing on to floor of dressing room. The dressing room should be provided with a seat of slate or marble; stalls should be 6 feet 6 inches high above finished floor and bottom of partition should be let into floor 1 inch.

The showers should be of a plain type with 5-inch cast-brass shower head with removable face attached to a ball and socket joint so that the angle may be changed to suit the bather. The shower should be controlled by means of an approved type of non-scalding valve with check valves on the supplies, which should preferably come from wall or ceiling instead of arising from the floor.

The hot-water supply may be provided for by the use of a tank and hot-water heater of suitable capacity, or a tank and steam coil in same if a high-pressure steam system is available. In the latter event the use of an instantaneous automatic hot-water heater is preferable to a tank with steam coil, being more economical in the consumption of steam and having the advantage in that the temperature of the hot water can be better controlled. Fire standpipes of 2 or 2½-inch diameter running from basement to top floor with 1½-inch outlets on each floor must be provided for, each outlet to have approved pattern hose reels with 50 or 100 feet of unlined linen hose and hose valves.

The foregoing summarizes as briefly as possible what should be used to equip our modern schools in a sanitary manner necessary to properly safeguard the health of our rising generation. Beyond question, sanitary plumbing in schools also becomes an unconsciously absorbed lesson in hygiene by children and instills into their minds in a forceful manner the necessity of cleanliness in all things as an aid to health, comfort and happiness.

And this feature, especially in our larger cities, where the school life and the home life offers so wide a contrast, is in itself not the least important part of education, and tends to carry into the homes, by the future heads of families, a realization of the great importance of good sanitation.

HOW WIND AFFECTS VENTILATION

The effect of wind against a building on its ventilation and heating was ably discussed in a paper presented by Mr. H. W. Whitten, of Detroit, at a meeting of the American Society of Heating and Ventilating Engineers at Indianapolis. Mr. Whitten premised that the most apparent effect is the inleakage of air through crevices, particularly those about movable windows and doors. In cold weather this inleakage becomes evident in the form of cold draughts which are often noticeable at a distance from the walls toward the interior.

The volume of this inleakage, Mr. Whitten continued, varies in proportion to the velocity of the wind, sizes of crevices, and means of egress of air from the building, and it is also affected in a small degree by the pressure exerted by the expanded warm air inside of the building. This pressure must be overcome before the outside air can enter. During the heating season this inleaking air, being of a lower temperature than the inside air is desired to be, must be heated. These phenomena are apparent and their effects are common knowledge.

Recent investigations have shown, however, that the variation in the volume of inleakage due to variation of wind velocity is much greater than was generally believed.

The least apparent effect, and in the opinion of Mr. Whitten the most important, is the outflow of warmed air through crevices in the sheltered sides of buildings. Windows and doors are constructed with the primary object of excluding draughts from outside, but are not so well adapted to prevent air currents escaping from the inside.

The wind strikes an obstruction, a building, is diverted from its natural course and is forced to pass by and over the obstruction. In doing this its speed is accelerated, the parted currents uniting at some distance beyond the building and resuming their normal velocity.

This action produces an area of low pressure in the lee of the building which acts as a partial vacuum. This partial vacuum acts as a continuous pump on the crevices of the lee sides. As the pressure of the inside warm air is naturally outward, the combination of this pressure with the partial vacuum outside produces a greater loss than is sustained on account of inleakage, assuming the aggregate amount of crevice on each side to be equal. This loss is greatly increased when other means than wall crevices are employed to admit outer air, such as cold air inlets for hot-air furnaces, supply inlets for indirect or fan systems, etc. This outward flow of air is not attended by disagreeable draughts and, unless special means are taken to detect it, is not evident to the senses.

Mr. Whitten mentioned some tests made by him last winter in this connection. In a rectangular school building with the ends facing north and south and stairway windows only in these ends, the east and west sides divided into rooms each having five 5 feet by 9 feet windows with usual clearance and sills on a level with the pupils' heads when seated, the heating was accomplished by a fan system designed to supply 1,800 cubic feet of air per hour per pupil with an inlet velocity of 750 feet per minute. With a northwest wind of 14.5 to 15 miles velocity and a temperature of 33 degrees, a room on the east side of the first floor, one room removed from the south end, showed an average rate of supply of 817 feet and a vent velocity of 340 feet per minute, inlet and outlet being of same size, the latter at the floor and the former 8 feet above and both on the side of the room opposite to the windows.

This showed a loss of 477 feet per minute. An air test showed 10 parts of CO_2 (carbonic acid gas) in 10,000. It was noted that there were frequent complaints from headache from the scholars. Other rooms on the same side showed losses of 350, 357 and 375 feet per minute, while a partly sheltered west side room showed a loss of only 160 feet, and another exposed to the strongest wind effect showed a supply rate of 410 feet and a vent velocity of 705. The average temperature of the east rooms at breathing level was 73 degrees, and at the floor 70 degrees, and of the west rooms, 68 degrees and 58 degrees, respectively.

Another school building with an 18-mile wind and 30 degrees outside temperature, heated and ventilated by a gravity indirect system, showed an average loss of 20 per cent. from the supply ducts in the windward rooms and an addition of 60 per cent. to the vent velocity, while the leeward rooms showed an increase of 30 per cent. in the supply velocity and a reduction of 62 per cent. in the vent velocity.

Under other conditions where there were a few corridor windows on the north side and schoolroom windows on the other three points, the air supply was found to be 2,340 feet and the volume passing through the vent 1,451 feet per minute.

A test made some years ago by A. B. Franklin, of Boston, on a school building with a 25 to 30-mile wind blowing toward a majority of the windows showed the following supply and discharge of air in cubic feet per minute:

	At inlet	At outlet
Room exposed	1,536	2,367
" "	1,533	2,307
" "	1,996	2,838
" "	2,244	2,990
" "	1,694	2,391
" "	568	1,154
" "	933	1,404
" partly sheltered	2,200	2,368
" " "	2,301	2,288
" " "	1,602	1,773
" partly exposed	2,517	2,777
" " "	1,609	2,031
" " "	2,253	2,762
" " "	1,389	1,653

In a high school building the question was raised whether the heating contractor had put in a competent fan system. The supply seemed of sufficient quantity and temperature, but the rooms on the exposed side could not be satisfactorily heated. After shutting down the fan the supply ducts were closed in the rooms on the exposed side and with all the doors and windows closed it was found that as much air was being removed from the vents as the fan was supposed to supply. The wind at the time was of moderate velocity.—*American Carpenter and Builder.*

St. Louis Public School Buildings

By WILLIAM B. ITTNER, F. A. I. A.
ARCHITECT TO THE BOARD OF EDUCATION, ST. LOUIS, MO.

THE public-school buildings of St. Louis are built to accommodate all the grades; that is, pupils may pass through all the grades from the kindergarten to the eighth grade, from which they are prepared to enter the high or secondary school.

As a rule the buildings will accommodate about 1,200 pupils and contain twenty classrooms, a kindergarten room, the equivalent of two classrooms, a room for domestic science, a manual training room, a principal's office, two gymnasiums and playrooms, toilets for pupils and teachers, and the necessary space for the heating and ventilating apparatus, fuel, etc.

In plan these buildings show a number of radical departures from the conventional type of school building, wherein the central corridor lined with rooms and wardrobes on either side is necessarily dark and without adequate ventilation. The effort has been to introduce outside light into the main corridor throughout the greater part of its length, insuring the penetration of sunlight to all parts of the building during some part of the day, and to arrange the wardrobes for outside light. It will also be noted that wardrobes are entered from classrooms only. This arrangement, though unusual, is found to give the teacher absolute control, adding to the decorum of the school, as well as enabling their perfect ventilation; the air current entering the room at the inner wall, making the circuit of the room, passing through the opening to and along the entire length of the wardrobe to the vent.

The general plan developed by these requirements is necessarily more or less similar in all of the schools, approximating in form the letter E. In all cases the sites have been wisely selected to permit ample space surrounding the building, affording generous playgrounds, as well as good light and air.

The classrooms are 24 feet wide, 32 feet 6 inches long, with a clear story height of 12 feet 6 inches; they are arranged for left-hand lighting only, the glass surface in no case being less than one-fifth of the floor area. The classrooms accommodate 54 pupils in the lower grades and intermediate grades, and 48 in the higher grades, and are equipped with single seats. Natural slate blackboards are placed on the three inner sides of the rooms, are 3 feet 6 inches in height and range from 2 feet in the lower grades to 2 feet 5 inches in the upper grades from floor to the chalk rail.

The wardrobes are 5 feet 3 inches wide, 16 feet long, and are provided with shelves and sixty hooks on the side walls, a portable umbrella rack is also provided for each wardrobe. A bookcase containing 65 running feet of shelving, a bracketed shelf over the blackboard at the front of the room, and a picture moulding completes the equipment of the classroom.

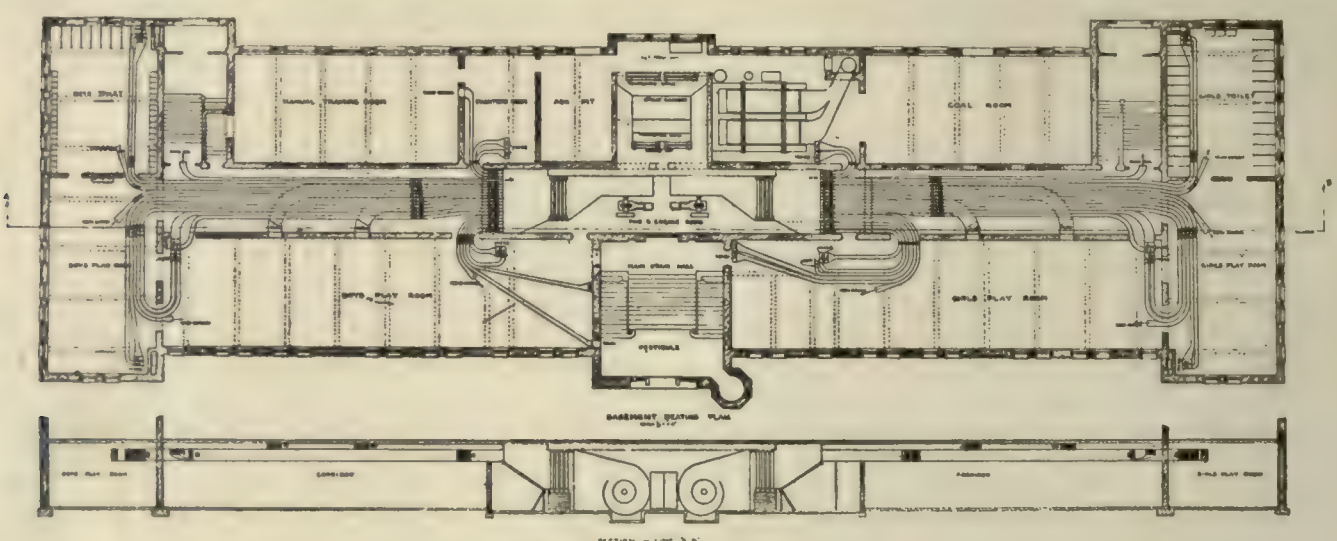


FIGURE 1

The corridors are 14 feet wide, with ample outside light, and give direct access to all classrooms and the stairways on each floor. Several lines of flush metal picture moulding are provided for the hanging of casts and pictures.

The stairways are placed at the ends of the main corridor and central to the group of rooms on either side of the central axis of the building.

They are always 5 feet wide, with ample landings, and are built with solid concrete balustrades; the risers and skirtings are of marble, while the treads are asphalt 1 inch thick. Treads of this character are not only non-slipping and practically noiseless, but are easily replaced when worn out.

The purchase of ample sites has made it possible to limit the height of the buildings to two stories. The basements are 15 feet in height and are placed well out

of ground. Where possible, a level entrance from playground to basement floor is provided, while the principal entrance leads directly to the first floor.

The first and second stories are 12 feet 6 inches in height, the ceilings unobstructed by beams and with window heads brought directly thereto.

All buildings are of fireproof construction, except the pitched roofs, in which cases, for economical reasons, the roofs are of mill construction covered with 1¾-inch matched sheathing and tile. All outer and interior bearing walls are of hard brick laid in Portland cement mortar. Interior non-bearing partition walls are of hollow tile, and the buildings are plastered with cement plaster.

The floors are constructed of armored concrete and finished with narrow maple flooring smoothed and oiled. Basement floors are of granitoid or cement.

A simple stencil frieze is provided for each classroom, while the kindergartens are decorated with mural paintings typifying the life of childhood. Walls and ceilings in the basement are coated with cold-water paint.

The plumbing is of the most approved sanitary type. Individual seat action closets are provided in the general toilets in the basement, and the emergency toilets on each floor for the pupils. The urinals are of glass, are automatically flushed and are of the ventilated type. Special provision has been made for the ventilation of the toilet rooms. Drinking fountains are installed in the corridors in the basement and playgrounds.

Each room is provided with a self-winding electric clock, regulated from a master clock with program ringing device located in the principal's office.

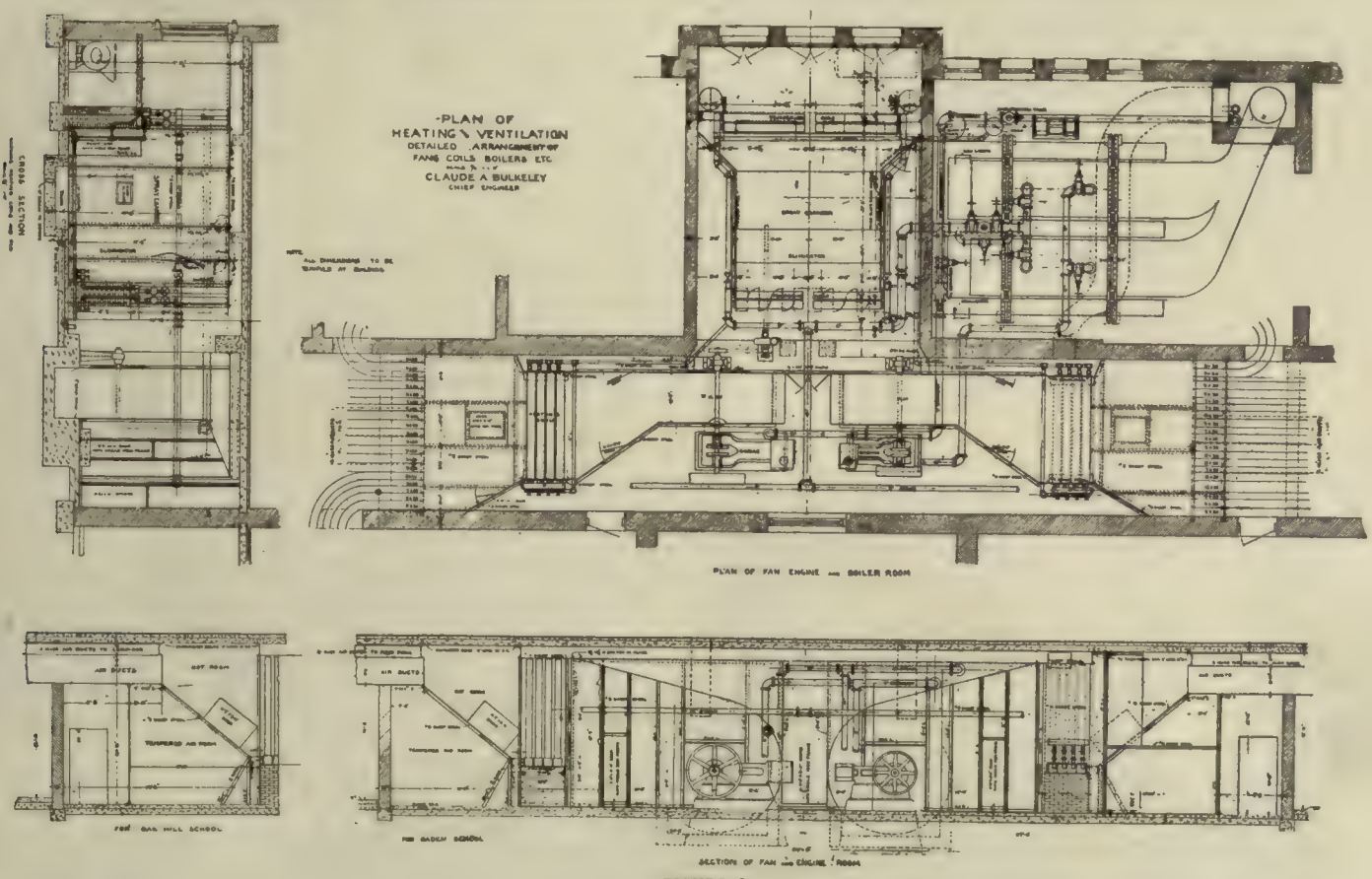


FIGURE 2

In exterior design the effort has been to avoid the use of extravagant material and ornamentation and the straining for effect not justified by the function expressed in the plan. In most instances the buildings are faced with ordinary hard and red brick mixed as to color and laid up with a large bed joint in garden wall or Flemish bond. Stone is used sparingly, and no attempt is made to accent any part of the building except the main entrance, which is generally dignified by fitting architectural treatment.

The interior finish is reduced to the minimum, such woodwork as is used is of oak in plain design. Classrooms and corridors are painted in lead and oil, the colors being carefully selected with respect to the location of each room and its relation to the point of compass.

The entire building is wired for electric lighting, the fixtures used being of the short-stem cluster type, equipped with holophane shades.

Aside from their desirability on the score of light and air, the large school sites have not only provided ample playgrounds, but have given opportunity in a modest way for object lessons in the art of landscape gardening, and each school ground has been made to present some distinct instructive feature, awakening an interest in the knowledge of decorative plants and their use in the embellishment of the home and the city at large.

All buildings are designed for a low-pressure steam plenum system of heating and ventilation, this work being carried on simultaneously with the plans of the building.

Fig. 1 gives the general basement layout of the heat-

ing and ventilating apparatus for the New Baden School, now in course of erection. The main portion of this building is to be two stories in height above the basement, with an ample lecture room located on the third floor. There are eighteen classrooms, a kindergarten and domestic science rooms, making an equivalence to twenty-one classrooms.

The mechanical equipment is designed to furnish the air for ventilation at a sufficient temperature to make up for all losses. Thus there will be no unsightly piping or radiators to contend with in any portion of the building. Each duct, with its sizes marked, runs to risers H-1 or H-2, according to whether it leads to a first or second floor room.

For a detail of the apparatus, reference is made to Fig. 2. The plant is designed to operate under a steam pressure of 15 pounds, with a back pressure of 2 pounds in the coils. The installation consists of two 8 ft. x 4 1-2 ft. fans, direct driven by 15 in. x 10 in. and 18 in. x 12 in. engines. The larger engine drives the centrifugal pump for the air washer, in addition to pulling its fan. This washer is located between the two sets of tempering coils in space marked "spray chamber."

This washer removes practically all foreign matter from the air by passing the same through finely divided sprays of water. An eliminator removes all excess free water from the air before it comes in contact with the next tempering coil.

The air enters through intake windows, indicated at top of plan, and immediately passes through the first tempering coils. The steam supply to these coils is controlled by a thermostat located in the intake and automatically turns steam into the coils at some point before the outside temperature reaches the freezing point, thus protecting the washer from freezing. By-pass doors are located at the side of coils and these are gradually opened or closed by a thermostat located immediately past the eliminator. Thus a constant temperature may be maintained for the air as it strikes the washer. This is a matter of considerable importance, as it has a bearing on the ultimate relative humidity of the air.

After passing the eliminator, the air meets the second set of tempering coils, which brings the air up to a temperature of 70°. The air then divides and passes into the two fans.

Referring to the "Section of Fan and Engine Room," each fan drives the air through the heating coils into the "Hot Room," and under the same coils into the "Tempered Air Room." Thus the tempering air is not heated after leaving the fan. A thermostat is located in this latter compartment, for controlling the by-pass doors under the second set of tempering coils, thus maintaining a constant temperature of 70°. Tempered air, hot air, or a mixture of the two is forced by the fan into the "Air Ducts." A thermostat located in each classroom controls the proportionate quantities by means of mixing dampers, and thus a temperature is maintained varying not in excess of one degree either side of a given point.

A fresh air supply of 30 cubic feet per minute is allowed for each pupil. This necessitates about eight complete changes of air per hour in every classroom. Since the corridors and basement are occupied intermittently, four changes per hour are planned for these lo-

EDWARD WYMAN SCHOOL
ST. LOUIS, MO.

WILLIAM B. ITTNER
ARCHITECT

calities. All plants are designed to secure these results with a safe margin of reserve in case it should be required for any reason.

The boiler installation consists of two 60 in. x 16 ft. return tubular units equipped with down-draft furnaces. One boiler will do the work at all times except in extreme weather, when both will be required. The installation of two smaller instead of one larger boiler is advantageous in a number of ways, namely: The small boiler will be more economical of fuel, as it will work at close to its rated output, a reserve unit is on hand most of the time, and less headroom is required, thus reducing the cost of general building construction.

Numerous smoke tests have been made to accurately determine the distribution of air in classrooms of various schools. These tests were made by burning a quantity of red fire powder in the duct where the same leaves the hot and tempered air rooms. This particular powder was selected on account of both its pungent odor and the quantity and color of the smoke, the former attribute making it very easy to determine when a room was thoroughly cleared.

The tests indicated quite clearly the air movement. The fresh air entering the room at a velocity of about 300 feet per minute was evenly distributed over the rear two-thirds of the room, and was gradually driven downward by the continued entrance of fresh air from above, and by the law of diffusion of gases. From the breathing line the air gradually worked both downward and forward to the wardrobe opening, and passed out and into the vent.

During the Christmas holiday recess of '06 and '07 extensive tests of the heating and ventilating were made in five newly constructed schools. Especial attention was given to the matter of air volumes, velocities and distribution. The smoke tests previously described were made at that time.

It may be interesting to note a few figures on fuel cost of heating and ventilating some of the schools. One matter drawing special attention is the fact that a new school requires above 10 per cent. more fuel to operate the first year than is required for succeeding seasons. A cause for this might be found in the fact that the walls are not thoroughly dried out at the start, and act as a better conductor for the heat.

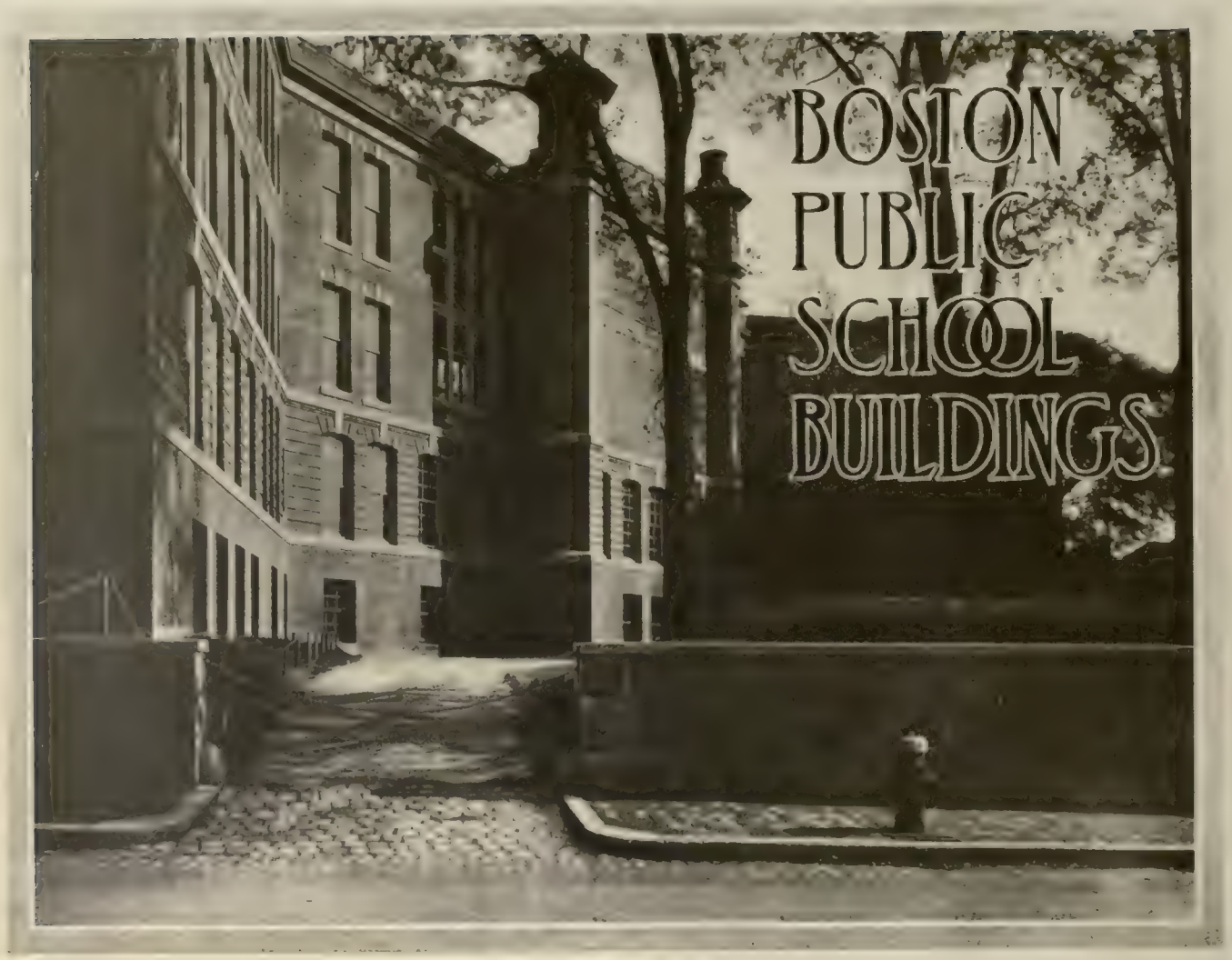
The figures given are for nine schools, and extend over a period of four heating seasons. All these schools are equipped with ventilating fans. During the four years the average mean temperature for the months requiring heat was one degree lower than the average for thirty-four years. The temperature figures are, of course, taken from the United States Weather Bureau statistics.

The total contents of the nine buildings amounts to 5,755,000 cubic feet. The average coal consumption per season for the four years amounted to 1,936 tons, or 673 pounds per 1,000 cubic feet contents. The average price paid for this coal was $1.90½ per ton, thus making the fuel cost per season for heat and ventilation amount to a little over 64 cents per 1,000 cubic feet. The coal was of the ordinary Illinois variety mined in the district immediately east of the city.

The above fuel cost of heating and ventilating amounted to about 12 1-2 cents per seat. Even if this entire amount were chargeable to ventilation alone (the item of heating being neglected), the fallacy of arguing against ventilating on account of extra fuel required is immediately shown, when an adequate supply of fresh, wholesome air can be provided for each child at so insignificant a sum as 12 1-2 cents for an entire heating season.

The foregoing brief description of the schools will not be complete without a statement as to costs. It will be seen by the following table that the cost, though fairly uniform, fluctuates somewhat more than might be expected in buildings of uniform character. The difference, aside from the fact that the building and labor market has advanced steadily since the first schools were erected, is due mainly to the difference in the sites purchased, some of them requiring an abnormal amount of grading and preparation for the buildings. The cost here given includes the preparation and improvement of the sites and the buildings complete, ready for their equipment of furniture.

Name of school with date of contracts.	No. of rooms.	No. of fixed seats.	Total cost.	Cost per cubic foot.	Cost per pupil.
Blow—					
January, 1904...	24	1,200	$150,980.92	$0.157	$125.81
Cote Brilliante—					
September, 1904.	24	1,200	162,829.01	.17	135.69
Clay—					
September, 1904.	24	1,200	159,406.54	.194	132.84
Shepard—					
January, 1905...	24	1,200	162,228.92	.165	135.19
Patrick Henry—					
January, 1905...	23	1,145	203,312.65	.180	177.56
Sigel—					
March, 1905....	24	1,200	158,595.88	.17	132.16
Hempstead—					
January, 1906...	24	1,200	180,560.80	.171	150.47
Wm. Clark—					
February, 1906..	24	1,200	188,902.00	.191	157.41



UNLIKE St. Louis, Chicago, New York and some other cities, the Boston School Department does not have an official architect to prepare designs for its school-houses.

About half a dozen years ago there was established the School-house Department—which must not be confused with the Department of Schools, which has charge of the use of the buildings after they are built and of the education and well-being of the pupils—under the charge of three Commissioners. This department has entire charge of the erection of new buildings and the selection of the architects who shall design them. In a very great degree it substitutes itself as the real client of the private architect, who has to satisfy its requirements rather than those of the City Government proper.

The mode of action under the Boston plan is about as follows: The School-house Department, being instructed by the School Committee that a new building is needed, studies the requirements, searches for and advises as to the site, recommends the amount it is desirable to spend, and procures the appropriation. Then, having carefully prepared a statement of the requirements, it selects from the general body of private practitioners one who seems likely to handle the work satisfactorily and then leaves the selected architect free to prepare his design and specification, subject always to the correction and final approval of the Commission itself. In this way it has been possible to fix and determine certain standards of arrangement and equipment and then, by careful watching, to discover how and where they may be improved. In other words, the Commission stands responsible for the skeleton, as it were, while the designing architect has to do only with the fleshings. It is plain, then, that these new school-houses must have a considerable variety of architectural expression, and it is equally plain that they would be likely to have quite as great variety in arrangement, accommodation and equipment but for the fact that these matters lie in the control of the Commission, and herein lies the safety of the present scheme.

The scheme as a whole is well devised, and it has been in operation long enough to produce a body of results that enable the observer to form an opinion as to the success of the experiment.

We believe that Boston architects generally are disposed to consider the method successful and have found themselves greatly assisted rather than hampered by the systematic methods devised by the Commission. And

from a pecuniary point of view the result to them is satisfactory, for the Commission divides the work into two parts, leaving it to the architect to design and construct the building, while reserving to itself the control and oversight of all that goes to constitute the "domestic engineering" of the building—the heating, lighting, sanitation and equipment. Upon the cost of gross construction the architect is paid 5 per cent., while upon the cost of the domestic engineering, material and labor he receives but 2 1-2 per cent., the Commission reserving an equal amount to cover the cost of preparing in its own office the drawings and specifications that these important elements call for.

The account of the St. Louis school-houses published states that the average cost per cubic foot for eight school-houses erected within the last three years was set down at 17 1-2 cents, carrying from 0.157 to 0.194. Now the average cost per cubic foot in Boston seems to be much nearer 23 cents than 17. Unfortunately, in the tabulation before us there is included but a single example of a twenty-four-room building such as are all of the St. Louis examples, and here the cost was 24 cents, which implies a cost per pupil of $146.32, as against an average cost per pupil in St. Louis of $143.40. The Boston building was built during the same period and the market conditions were therefore the same, or at least as nearly the same as they ever can be in two widely separated places.

The Commissioners have under their charge 221 school-houses in occupancy, and at the time of the issue of their last annual report there were five new school-houses building but unfinished. Very nearly one-half of these buildings were erected more than twenty-five years ago, the oldest building in use having been built in 1824; they have, therefore, in most instances, no shadow of a right to be considered anything but dangerously combustible. In fact, the only school-houses of really fireproof construction are those recently erected by the present Commissioners, although all those built since the great conflagration of 1872 have had progressively incorporated in them fireproofing material and devices that accorded with the knowledge of their day in the science of fireproofing. Because of the age, hard use and neglect of so considerable a proportion of their charge, it is easy to see that the annual outlay for repairs must be large. In fact, the Commissioners, who do not have a regular stated annual appropriation, but have to depend on securing such sums as the Legislature is willing to allow, have been seriously crippled in their building operations by the steady drain upon their funds which is occasioned by necessary, sometimes excessive, repairs.

The school authorities have adopted the system of unilateral lighting, and the architects who have designed the newer school-houses have shown much ingenuity in adapting their plans so as to meet this stipulation. Their solutions of this problem are often very interesting, and their treatment of the considerable areas of plain wall without door or window openings, which also result from this requirement, seems in most cases to be very satisfactory. At the same time the Commissioners admit that circumstances may arise where, through the general instability of a site affected by the position and height of neighboring buildings, bilateral lighting must be adopted in some of the rooms, if they are to have the minimum amount of illumination their use demands But the admission of a sufficient amount of light is not the only consideration; regard must be had for its proper diffusion, and more careful provision should be made to prevent its needless absorption. In other words, the surface finish of walls, ceilings and floors should be the best for their purpose, and the color given to them should be determined by competent specialists.

Of course, the great invariable light-absorber in schoolrooms is the standard blackboard, whether of natural slate or an artificial coating applied to plaster or wood. Against the use of these blackboards Dr. C. H. Williams, the oculist who advises the school authorities and has devised and directs the methods used in the examinations of pupils' eyes now established by law, is waging war and hopes to bring about the substitution for them of light-colored surfaces upon which colored chalk can be used in place of white. We will go farther and point out that if, in place of colored chalks which would crumble into dust just as white chalks do, there should be used on these light-colored "blackboards" crayons compounded with wax or grease a distinct hygienic gain would be made at the same time the diffusion of light was promoted. No small amount of the dust in schoolrooms has its origin in the chalk used on the blackboard, and the less dust schoolrooms contain the more surely will respiratory and pulmonary diseases be avoided.

In approaching their work, at the outset, the Commissioners perceived that not only their own work but that of the architects who would have to work under them would be greatly facilitated if they could discover and fix standards which, as units, could be used over and over again, not only in different buildings, but in compiling the arrangement and composition of a single building, and their attempts to "standardize" their requirements have been markedly successful.

Perhaps the most interesting "standard" they have fixed is that 22 cents per cubic foot is a fair and proper cost for a "first-class" school-house as defined by the Boston building laws, and it must be understood that the Commissioners' attempts at standardizing have been both helped and hindered because of their having to conform them with the provisions of the general building law.

In operation it has been found, in the case of the twenty-two buildings completed by the Commissioners, buildings which provide accommodation for 18,500 pupils, that in sixteen cases the standard cost has been exceeded, though in six of these cases by but a single cent per cubic foot. In another six cases the final cost was standard or less. The test of experience seems to show that the standard cost per cubic foot of "first-class" school-houses under the Boston building law is 23 cents.

All school-houses are to be built of "common" brick, with or without stone finish, and the smaller buildings are to be relatively less ornate than the larger ones. Of course, there are exceptions to all rules, and it was decided to build the Charlestown High School-house of granite, a happy conclusion since, because of the similarity of material, it groups better with the shaft and

THE NORMAL AND LATIN SCHOOL GROUP—VIEW LOOKING NORTH

office-building of Bunker Hill Monument standing in its park just opposite.

Further "standards" may be discerned in the "General Information for First-Class Construction" that with certain diagrammatic illustrations of standard methods of fitting wardrobes, cooking-rooms, manual-training-rooms, lavatories and so on are republished with each annual *Report*. For instance, classrooms in primary schools are to measure 24x30 feet, while in grammar schools they are to be 26x32 feet, 13 feet in the clear. Window glass, in small panes, is to equal in area one-fifth of the floor space of the room lighted. Corridors in small buildings are to be 8 feet wide, or 10 feet in the larger buildings. General toilet-rooms, preferably in the basement, are to be provided on the girls' side with two water-closets per classroom, while on the boys' side one closet per classroom is allowed, but, in addition, slab urinals having a running length of 36 inches per classroom are to be provided. In addition to this equipment there is provided on each floor two so-called "emergency" water-closets, one for boys, one for girls.

It is quite impossible to give an adequate idea of the standardizing that has been developed in the department of domestic engineering unless by practically giving complete specifications for heating, ventilation, plumbing and artificial lighting, and this is obviously impossible here; even in skeleton form the statement of the standard requirements consumes many pages in the Commissioners' *Reports*.

But in spite of the care with which the scheme has been worked out and after the thorough trial it has had, the Commissioners announce a qualified dissatisfaction with the present method of school building that they are obliged to administer. They announce their preference for extending their own control, and now desire to have the architectural designing done in their own office just as already the domestic engineering is there looked after by the staff of engineers regularly in their employ. They propose the substitution of a single architect, an official one to be sure, who shall carry out the intentions of the Commissioners just as private architects now try to do. The Commissioners would still continue to be the final and controlling authority.

TYPICAL SCHOOLS IN NEW YORK, CHICAGO AND ST. LOUIS.

An appendix to the Annual Report of the Boston School-house Department.

THE New York type is a most skilful adaptation of the necessities of a city block to the requirements of a school, and the development of the plan that is bounded by party walls is particularly good. The chief requirements are (1) for the classrooms, light; (2) for the playrooms or gathering spaces, including gymnasiums, accessibility and light, but the latter not so all-important as in classrooms; (3) for the assembly hall, accessibility and a large area, and light; the last no longer of supreme importance, as artificial light will answer, and in many cases (lectures with stereopticon or evening meetings) daylight is of no importance; and (4) the corridors, sufficient for easy circulation with ample light, the stairs sufficient in number and so placed as to allow rapid emptying of the building.

This New York type meets these requirements admirably. (1) The classrooms get their light from central areas that cannot be interfered with by other buildings, the distance between the arms of the H (about eighty feet) insuring ample opening to the sky. On the lower floors, and especially in the rooms near the internal angles, a larger amount of glass is desirable than what would be ample on the upper stories. The corner rooms have prism glass to help obviate this. (2) The playrooms or gymnasiums occupying the basement or the street floor, or both, if two stories high, are very convenient and are so planned as to have good daylight. (3) The Assembly Halls, having the gallery on the first floor level, have the main floor but a short flight of stairs below the sidewalk, and are as accessible as it is possible to be. (4) The corridors occupying the space against the party wall depend on light borrowed from

the rooms and on light from the small area placed about in the center between streets on the party wall. At a slight sacrifice of exterior wall (*i. e.*, classroom space) they might have been carried through to the front, and had really good light. The stairs are well placed, and, being of the twin type, are double the number that appear on the plans. We believe that a single good staircase at each of these points would be better than a twin staircase, with its feeling of enclosure and of cramped headroom, and the slight confusion caused by the alternating direction of landings, but New York has found them very satisfactory in operation. Incidentally they require a slightly greater distance from floor to floor than what is used in Boston. The plan as a whole answers the chief requirements of a modern school building admirably. The system of wardrobes which in New York has been in corridors and does not seem to be ideal has been replaced in this building by wardrobes with sliding doors, occupying one side of the classroom. The development of this idea is shown in a suggested plan coming from Chicago, which will be noted later. If it proves practicable, it will be economy as compared with the Boston type—independent little rooms adjoining the classrooms, which is a plan extravagant in area.

The De Witt Clinton High School is an excellent example of the H plan applied to a city block with light on all four sides. The bars of the H have a thickness of two classrooms and a corridor, the cross-bar is nearer one street and leaves open areas of unequal sizes. The larger, in basement and first floor, forms the Assembly Hall. The smaller, in basement and part of the first floor, forms the gymnasium. The Assembly Hall, with its stage, etc., occupies not only the central area, but all the classroom space on the three sides, and the gymnasium occupies the central area at the rear and the classrooms adjoining. This is an excellent block, good rooms, well-placed stairs and economical corridor space, the latter possibly too economical to insure ample outside light, especially when wardrobes are placed in it. The stairs are the twin type. The exterior is a system of bays, which does not express the plan and in many cases gives inadequate light for rooms, which, except for the requirements of the exterior, might have had ample light. This, however, is no reflection upon the general principle of the plan.

New York depends on a certain amount of direct heat in all rooms, a distinct economy (perhaps a justifiable one), over a complete plenum system, but we feel that fresh air is as important as abundant light. Possibly we provide more than is essential; at all events, the Board receives frequent complaints as to draughts.

The Chicago plan is a logical development of the New York block plan. It occupies a complete lot about 300 by 300 feet in size (larger than a New York block). In some respects it is a step in advance of the New York plan. It contemplates having a low basement, given up wholly to heating apparatus, the heating, unlike the New York plan, being wholly from fan. The first floor is on the street level with the Assembly Hall in the center wholly top-lit, and the rooms surrounding it comprise not only classrooms, but also the playrooms, toilets, etc., which would ordinarily be in the basement. The toilets in this plan are distributed on the various floors. The playroom is also equipped as a gymnasium. It is quite ideal to have so much on the street level, and having no children in the space below grade is a very decided advantage. On this large plan of sixteen rooms on a floor, there is opportunity on this first floor for the playrooms for the boys and girls above referred to, for the offices of the administration, and also for six classrooms. The Assembly Hall is accessible from all four corners. Additional light for the boiler-room below is obtained by making the rooms of administration, which are all small rooms, of lower stud, the floor being above the general level of the first floor. Tested by our floor plan test this gives the following results, showing that it is not an economical floor plan, for notwithstanding the economy of the small wardrobes, the upper floor plans are considerably more than twice classroom area:

Cubical contents	1,835,475	cubic feet
Area, second floor	27,114	square feet
Area, 16 classrooms.....	11,616	square feet
Cubic feet per classroom (54)...	33,990	cubic feet

On cubic contents it is far below our limit of 40,000 cubic feet per class-room. Here there are six classrooms on the first floor and sixteen each on the second, third and fourth, a total of fifty-four, which would allow with us a cube at 40,000 of 2,160,000. It is, however, to be noted that the rooms, 22 by 33, are the area of our primary standard (24 by 30), and will not accommodate an average of fifty. So that from the point of accommodation it is not yet reduced to the economical minimum. The points about the plan which seem to have a direct bearing on our problems are the abandonment of the occupation of the basement by anything except the heating apparatus, and keeping the first floor down, and distributing the toilets on the various floors, thus reducing the amount so as not to have additional expenditure. Instead of separate wardrobes it is proposed to utilize the wardrobe in the room as the mouth, as it were, of the vent. All foul air goes through the wardrobe and then out. It is doubtful if this is hygienically wise, and the varying bulk of clothing hung there might have a distinct influence on the flow of air. The wardrobes are closed by doors that slide up, and which, when down, have blackboard surface. On a very large plan—and both the Chicago and New York schemes require a very big building—there is space to spare on the first floor for a few classrooms, and compared with a building having a basement and three stories, this building, even without an additional story, would have a large accommodation, and with an additional story the classrooms on the first floor would be a net addition over the old scheme of three stories, although the top floor, the fourth, would be but a half story higher than the other third floor. The through corridors with their ready access to either street are excellent, and even on the first floor are well lighted.

Both these plans, however, presuppose schools of such size as are never contemplated for Boston, and hardly likely ever to be required. The St. Louis type is therefore much more of an attempt to solve our own problem here. The plan illustrated is a fair example of an ideal open, well-lighted school, a very large lot, admitting of an extended plan and a twenty-four room

building on two floors only. All this is quite ideal, but, until land and building are cheaper, it is too ideal a plan for any part of Boston, except outlying suburbs, like the borders of West Roxbury, where land is still cheap. This building, judged on its cost per cubic foot, is economical and the price far below what we must pay per cubic foot. Examined, however, by the standard of accommodation, it is seen to be an expensive school, and the cost per cube is low only because corridor and roof space, of no service educationally, are less expensive than classroom space. The plan is a generous one, its area being far more than double the area of the classrooms; its cube is excessive, being more than 30,000 cubic feet per classroom. On our standards, twenty-four classrooms at 30,000 cubic feet would have given the limit of the cube as 720,000, but the St. Louis cube is 977,200 cubic feet; and 22 cents by 720,000 would have put the cost at $158,400, but the St. Louis school cost $190,000. To be sure, this $158,400 is the Boston "low limit," which has rarely been reached, but the Sarah J. Baker school, a twenty-four-room building, as is the St. Louis one, was built, without bonus, for $157,344.23. We may at least learn from the St. Louis school the desirability of keeping our suburban schools strictly to two stories in height.

Public School Buildings in the City of New York

By C. B. J. Snyder, F. A. I. A.
Superintendent of School Buildings, Board of Education,
New York City

THE total enrollment of pupils in the public schools of the City of New York is given as upwards of six hundred and twenty-thousand, who are housed in five hundred and ninety-four buildings, forty-eight of which are leased. The annual increase in school enrollment is from twenty-three to thirty-six thousand, in which increased immigration forms a very important factor.

For some years the city steadily outgrew its school accommodations, as owing to lack of funds and other reasons equally cogent it was impossible to carry fully into effect the plans which were made to provide enough new school buildings each year to care for the natural increase and for a goodly proportion of the pupils there receiving only part time instructions owing to the overcrowding of the schools in the neighborhood of their homes.

Both the pedagogical and the physical care of the public schools are under the direct control of the Board of Education, consisting of forty-six members, serving without pay, who are appointed by the Mayor in accordance with the City Charter, which prescribes the number to be selected from each of the five boroughs into which the city is divided.

The various working committees of the Board are appointed by its president; the Committee on Buildings consisting of nine members, having direct control of the Building Bureau with its force of clerks, draughtsmen, and inspectors.

The chief of this bureau, under the charter, must be an architect or an engineer in good standing, and is the executive officer of the board in respect to all matters relating to the bureau, and is charged with the preparation of plans and specifications and the supervision of all work on the buildings under control of the board.

Funds for the construction and equipment of new buildings and additions, as well as for the purchase of sites, are provided by the issue of corporate stock, under authority granted by the Board of Estimate and Apportionment and the Board of Aldermen.

During the year 1906 alone, upwards of ten millions of

dollars were thus provided with which to meet the contracts let during that year by the Building Bureau.

Thus we have, on the other hand, the yearly requirement that provision shall be made for housing the thousands of new school children, and on the other hand the enormous sums required therefor.

The growth of the city seems to lie along two distinct and entirely dissimilar lines; the first being the rebuilding of the older portions where the old single family houses have given place to flats and tenements, housing from four to twenty families each with the consequent enormous increase in land values, and the second, in the outlying sections where the farms have been cut up into building lots, with the usual development of one and two family houses, although here and there the transformation from a cabbage patch to four-story tenements within twelve months is not uncommon.

Thus there are serious problems, the most important of which, especially in the older portions of the city where land values are greatest, often being in excess of $12 per square foot, is that of economy in planning so that every inch of available surface may be utilized to its fullest extent.

Long and careful investigation, extending to the schools of France and Germany, caused the writer to reach the conclusion that there was a tendency in this country to construct classrooms of too great an area for the accommodation of a given number of pupils, resulting in poor lighting in other than corner rooms, greater expense in construction and undue strain on the voice of the teacher.

Especially unnecessary were the larger rooms found to be where there was also provided a gymnasium or an assembly room or both. This study and investigation was prompted by the belief that the enormous problem which confronted the educational authorities of this city could be successfully solved in no other way than by treating it purely as a commercial proposition, and while the writers on school-house construction varied some 50 per cent. in the estimated size of schoolrooms for a given number of children, yet experiment proved most conclusively that under nearly all conditions the 660 square feet per room alloted by some of the German authorities was ample and there was no material gain by increasing the area to 950 square feet, or, as in some cases, even more.

It has been found further that even the area of 660 feet may at times be reduced and still satisfactory results be obtained.

The lower easterly side of the old City of New York has suffered more than any other portion from overcrowding, notwithstanding the fact that several new schools, seating from 2,000 to 4,000 pupils each, have been build in this district each year, until there is one on almost every other block, and yet others are needed.

This increase in population has arisen from the replacement of the old one- and two-story houses with those of five and six stories before referred to, with a corresponding increase in land values, until the purchase of a school site involved such an enormous outlay for land alone that the erection of a ten-story school-house was seriously contemplated, and undoubtedly would have been carried out had not the opening of one of the new bridges across the East River reduced somewhat the congestion.

A school site selected about this time in this section, having a frontage of 200 feet and extending back 200 feet on one street and seventy-five feet on the other, cost the city through condemnation proceedings the sum of $572,000, exclusive of one lot of the site already owned by it.

The requirements were for a building to provide for about four thousand pupils, also for a large assembly room, two gymnasiums and other necessary features, it being for both boys and girls.

In this building, known as Public School 62, the foundations go down some 28 feet below the street level. The heating and ventilating apparatus occupies the subbasement, which is under only a portion of the building, and also a part of the basement, the balance being devoted to a large assembly room which with its gallery, which is placed at about the level of the street, will seat approximately 1,600 pupils, and is used also for evening lectures delivered to the citizens of the neighborhood.

The first story, aside from the space used for the assembly room, is left open as an indoor recreation space, while on each of the four floors above there are twenty classrooms, together with toilets for teachers and pupils. The sixth story with its splendidly lighted spaces by means of the peculiar roof construction, which does not show from the front, is utilized for classrooms, gymnasiums, manual training and domestic science rooms.

Four elevators and eight stairways are provided, so arranged that the building may be vacated by its 4,000 occupants, using the stairways alone, in two minutes and forty seconds.

This, as well as all other of our school buildings, even including those two stories in height, are of fireproof construction throughout, and a description of the materials used in P. S. 62 will apply in nearly every other case as well.

The floor construction is usually of segmental terra cotta blocks, or some form of reinforced concrete construction, none of the flat arch systems however being used. Level ceilings are secured by the use of channel iron furring attached to the beams by special clips, upon which is secured one of the several standard types of metal lath.

The stairways are all of steel with cut stone or asphalt treads, and are enclosed from bottom to top with partitions on the corridor side made of wire glass set in steel frames, access being had to each landing by means of fireproof doors, all fitted with automatic check and spring. What we term a double stairway is used almost exclusively, the height of each story from floor to ceiling being 14 feet 3 inches, to which is added the thickness of the floor construction of about 1 foot 3 inches, affording sufficient head room to obtain a platform at an equal distance between floors.

This arrangement of stairways permits of a great saving in floor space, and, while quite confusing to a stranger, is highly appreciated by the teacher, who finds in them the certainty of easy and complete control of the pupils, and the pupils themselves quickly realize the fact that in these stairways lies perfect safety from the perils of fire, smoke, or overcrowding.

The first story being used for an indoor playroom is paved with rock asphalt and the walls wainscoted with glazed brick to the height of 5 feet 6 inches, the space above, together with the ceilings, being finished in hard white plaster.

The interior trim of this building is of ash, the specifications being drawn so as to permit the builder to use either oak, ash, cherry or birch, as he may elect, it having been found that the city many times reaps a substantial advantage in thus permitting the builder to take advantage of the market.

This principle is carried out also in the specifications for the stairways where the builder may use either North River bluestone or asphalt for treads, also in the use of second quality white enameled or a salt-glazed brick for the wainscot of playrooms and side walls of outside toilets, and also in such other materials as will permit of securing goods promptly and not tie the builder to one particular dealer.

Extreme difficulty, however, has been experienced in applying this principle of open competition to hardware, and after many trials of different schemes to bring the hardware men all to precisely the same standard of weights, material and workmanship, resort has been had to the drawing of specifications having for the principal elements that of weights and dimensions as presenting the only solution of the problem.

All wardrobes are placed at the corridor side of and communicate directly with the classroom so as to have the clothing immediately under the eye of the teacher.

A steam coil is placed along the base so as to dry the clothing when damp, this source of heat being also an aid in the ventilation of the wardrobe, which is sometimes accomplished through the wall into the corridor and again into special flues.

All of the corridor, storeroom and toilet room floors, are finished with rock asphalt, a durable, sanitary and cheap material, but altogether unsightly. No good substitute has, however, been found for less than three times its cost.

Dust chutes are provided at each end of the building leading to fireproof bins in the basement, which are connected with a flue so that if the contents should become ignited the smoke would be carried off without entering the building.

The cost of the building was as follows:

School 62. Borough Manhattan. Year 1903.

Total accommodation, 4,250. Cubic contents, 1,918,000. Area second floor, 22,439.

Number classrooms, 104. Cubic feet per classroom, 18,442.3. Area classrooms, second floor, 14,014, equals 62.5 per cent.

Various Contracts	Contract Price	Per Cent. Total Cost	Cost Per Cubic Foot	Cost Per Pupil	Cost Per Classroom
Building	$518,000	.822	.270	$121.88	$4,980.77
Heating	54,293	.086	.028	12.78	522.05
Sanitary	38,666	.061	.020	9.09	371.79
Electric	19,560	.031	.010	4.60	188.07
Elevators, not installed	.....	.....	.....	.....	.....
Totals	$630,519	1.000	.328	$148.35	$6,062.68

Remarks.—Duplicate sub-basement. Auditorium with gallery not subdivided. Four large elevator shafts. Only one classroom unit on first floor; nineteen units given to gymnasium, lockers, baths, cooking, shop and offices.

Public School 38, Clark, Dominick and Broome streets (see plate 104), is in that section of the lower west side of the town where the rebuilding has but more recently taken place. On the opposite corner at the right of the school may be seen some of the old houses typical of this entire neighborhood, while on the left and close up to the school walls is the first of a row of ten-family tenements.

The old school building is directly opposite, and when the new one was planned with its fifty-three classrooms, more than double the number of those in the old, it was believed that care should be taken of the increase in school population of this neighborhood for several years to come.

The speculative builders of tenements, however, carried their operations to such an extent, using the size of the new school as an argument, that although it has been open only a year, it as well as the old building is filled.

Naturally this has a tendency to very largely increase

the taxable values of the neighborhood and as such is a paying investment for the city.

This increase in values, due to the active operations of builders soon after a new school is started in a neighborhood, is evidenced in almost every case, there being instances where such increase has been upwards of 300 per cent. in two years.

The question of an outdoor playground is a serious one in such cases as that represented in Plate 3, where the tenements at the right and left extend back along the rear of the school wall to within twenty feet of each other, rendering the rear of the school premises dark if set off for an outside yard. The difficulty is met by enclosing the entire area of the lot on the first story and using it for an assembly room and indoor playroom, while the actual outdoor play space is on the roof of the main building where an abundance of light and air may be had.

The cost of Public School 38 was as follows:

School 38. Borough Manhattan. Year 1904–1905

Total accommodation, 2,500. Cubic contents, 1,447,254. Area second floor, 15,560

Number classrooms, 53. Cubic feet per classroom, 27,307. Area classrooms, second floor, 8,928, equals 57.4 per cent.

Various Contracts	Contract Price	Per Cent. Total Cost	Cost Per Cubic Foot	Cost Per Pupil	Cost Per Classroom
Building	$305,000	793	.211	$122.0	$5,735.9
Heating	35,250	.092	.024	14.1	665.1
Sanitary	32,489	.084	.023	1.30	613.0
Electric	11,775	.031	.008	4.7	222.1
Totals	$384,514	1.000	.266	$153.8	$7,236.1

Remarks.—Roof playground.

The Morris High School (plates 89 and 90) is unfortunately placed upon a street only forty feet in width, the plot having been selected for a small high school, but owing to delays caused by the revision of the city charter and other matters, the final orders were for a building to care for at least 2,500 students, and neither change nor enlargement of the site was possible.

The principal dimensions of the building are frontage 312 feet, depth of wings 104 feet, height of tower 179 feet.

The assembly room is placed at the rear, so as to be easily accessible for the general public for lectures and other purposes.

The cost of building was as follows:

Morris High School. Borough Bronx. Year 1900

Total accommodation, 2,630. Cubic contents, 2,679,500. Area, second floor, 22,430. Area classrooms, second floor, 10,360, equals 46.2 per cent.

Various Contracts	Contract Price	Per Cent. Total Cost	Cost Per Cubic Foot	Cost Per Pupil
Building	$467,483	.789	.175	$177.75
Heating	49,447	.083	.018	18.80
Sanitary	37,445	063	014	14.24
Electric	28,886	049	.011	10.98
Elevators	9,000	016	.003	3.42
Totals	$592,261	1.000	.221	$225 19

Remarks.—Sub-basement, rock excavation. Auditorium extension. Large tower

17 units devoted to offices, library, lecture rooms, lockers.
14 units to gymnasiums, providing for 5 classes, equals loss 9.
16 units to laboratories providing for 12 classes, equals loss 4.
TOTAL 30 units not providing accommodations

The Stuyvesant High School occupies a plot on Fifteenth street, near First avenue, and running through to Sixteenth street.

The requirements were for a manual training high school of the most advanced type.

It has therefore been planned with the shops on one street and the class of section rooms on the other, these two portions being connected by a central corridor upon each side of which are the laboratories.

This leaves two large, light courts at the foot of which are the assembly rooms and gymnasiums.

This permitted of a complete separation of the shops from the balance of the building and simplified the floor framing, so that covering the shops it is built to carry 300 pounds live load per square foot, excepting in the foundry, where it was increased to 600 pounds to the square foot. The floor systems for the balance of the building are designed to carry not more than 75 pounds live load per square foot.

The floor arches for the shops are of concrete—broken stone, sand and Portland cement—while 6-inch segmental terra-cotta arches are used elsewhere in the building.

The equipment is not complete at this writing, but while the general construction cost was only about 18½ cents per cubic foot, with a cubical displacement of 3,291,650 cubic feet, yet the equipment consisting of high power boilers, electric generators (in duplicate, one set being operated by a steam turbine and the other by a 125 horsepower reciprocating engine), iron and brass foundry or molding room, forge rooms, machine shops, pattern-making shop, wood turning, etc., will bring the cost per capita to rather a high figure.

The De Witt Clinton High School (plate 50) covers solidly the block of 200 feet front on Tenth avenue, between Fifty-eighth and Fifty-ninth streets, by 200 feet in depth, and was designed for 3,000 students.

This is an example of the application of the commercial idea in the erection of a high school, for while outdoor space for recreation is desirable in a building of this character, it is not essential, and has therefore not been provided for.

The basement is devoted to a gymnasium 60 x 140 feet, the necessary lockers, shower and dressing rooms, teachers' lunch room, storerooms, etc., also the lower floor of the assembly room, which with its gallery and platform, seats 2,250 people. The entrance is through the foyer, which is on a level with the gallery floor, Fig. 5. The lighting of the room is by skylights in the bottom of the court facing the front.

The cost of the building was as follows:

School D. W. C. H. S Borough Manhattan Year 1903–1905

Total accommodation, 2,835. Cubic contents, 3,650,967. Area, second floor, 29,515. Area classrooms, second floor, 16,800.

Various Contracts	Contract Price	Per Cent. Total Cost	Cost Per Cubic Feet	Cost Per Pupil
Building	$650,400	.802	.178	$229.4
Heating	59,864	.074	.016	21.1
Sanitary	49,174	.062	.013	17.3
Electric	37,658	.046	.012	13.3
Elevators	12,633	.016	.003	4.5
Totals	$809,729	1.000	.222	285.9

(Plate 91.) The Wadleigh High School, on 114th and 115th streets, near Seventh avenue, is built on a plot of ground near the center of the block and running through

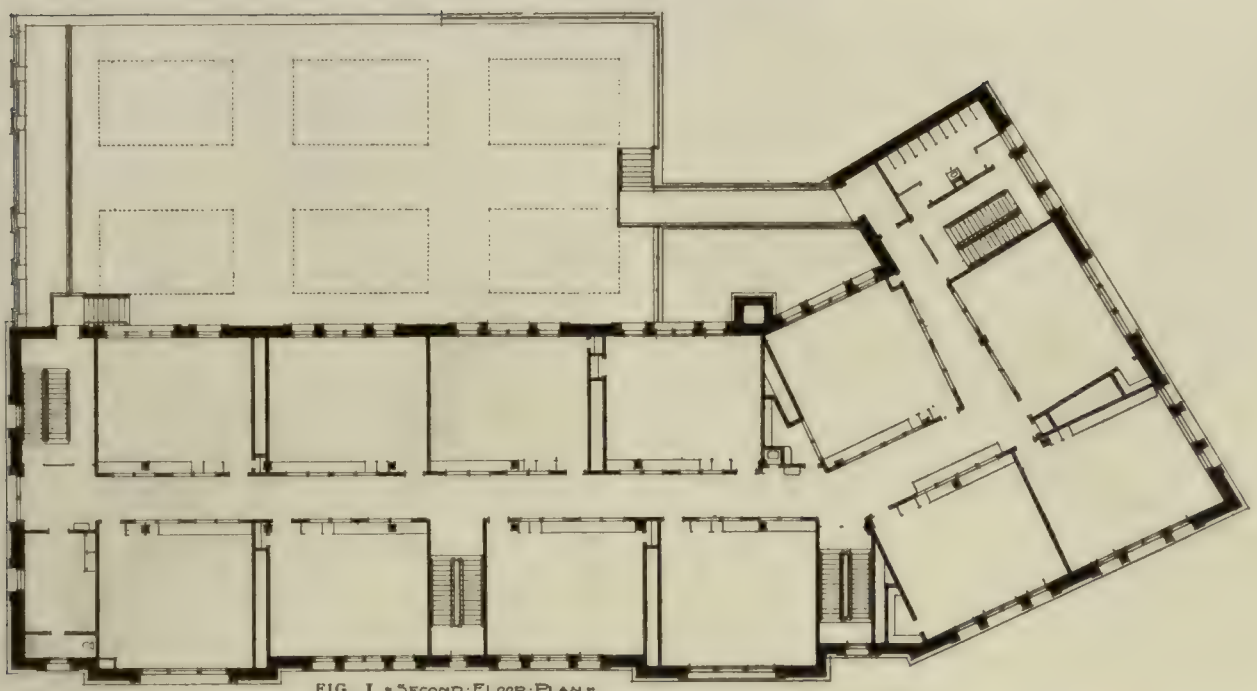


FIG. 1.—SECOND FLOOR PLAN—
—Public School 3 Manhattan—

from street to street. It was therefore planned of the H type, the courtyard on the front being devoted to trees and flowers, while a portion of the central or courtyard space at the rear contains the assembly room, with entrances directly from 115th street for the use of the public.

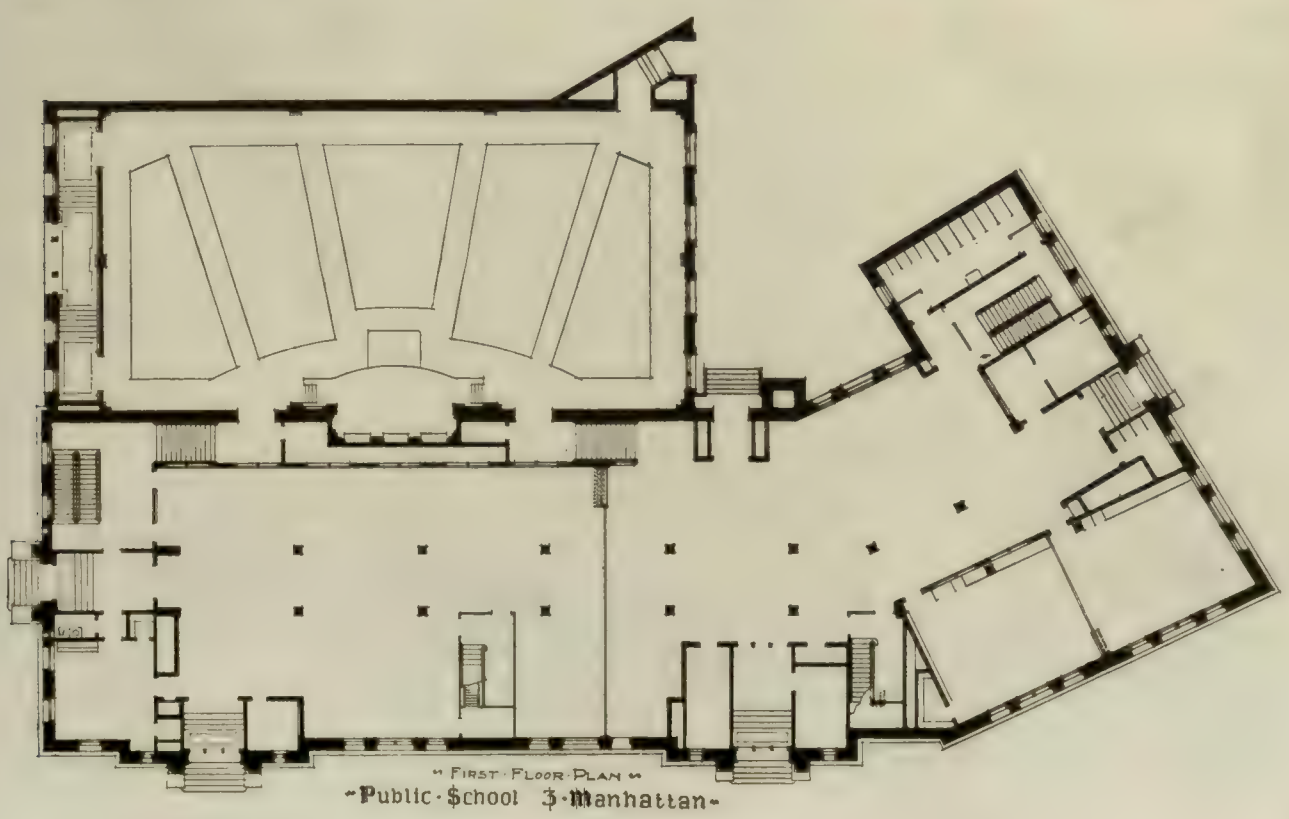
The cost of this building was substantially the same as that given for the Morris High School.

(Plate 103.) Public School 31 (formerly P. S. 167), at 144th street and Morris avenue, the Bronx, is one of several of this type, erected at about the same time (1898), wherein is given the maximum amount of light.

The cost was as per table at end.

Public School 165, on 109th street (plates 93 and 103) near Broadway, is of the H type, as the plot is in the center of the block running through from street to street.

Tenements have been built solidly up against it on each street, but owing to the plan whereby the light for



" FIRST FLOOR PLAN "
—Public School 3 Manhattan—

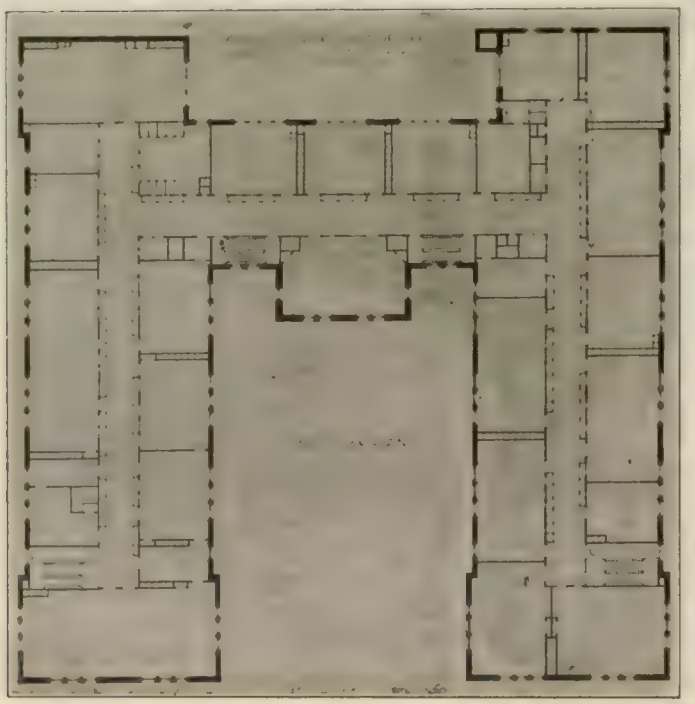


FIGURE 4

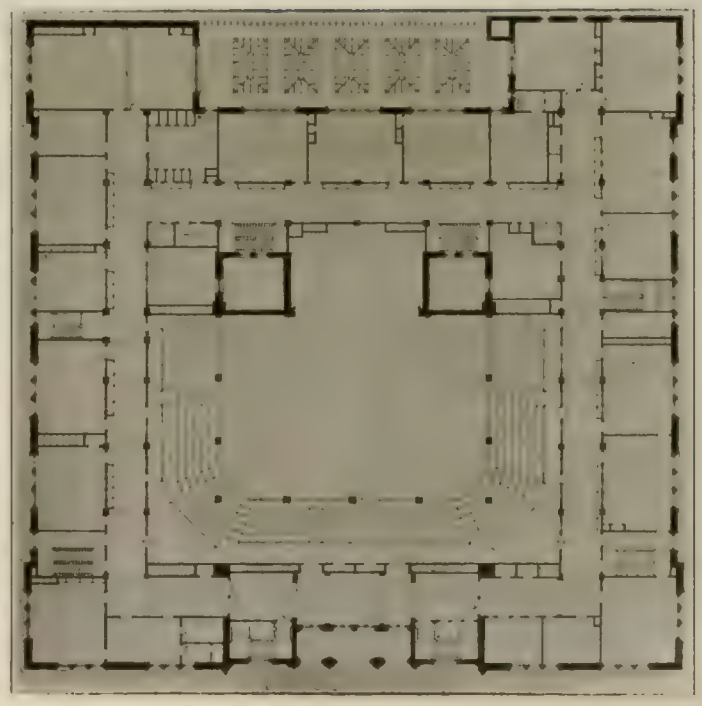


FIGURE 5

the classroom is received direct from the court fronting the street and formed on the school premises, there is no interference therewith.

The building accommodates 3,100 pupils and was built in two sections at different times and under adverse conditions and the cost thereof is therefore of little use for comparative purposes.

Public School 3, Hudson and Grove streets, replaces the one that was over fifty years old and that was burned about five years ago.

The plans for the new building were started on the morning after the fire and completed in record time. The number of classrooms in the new structure is nearly 50 per cent. greater than in the old. There was not sufficient space for an assembly room without its being used also for classroom purposes, and as it is the policy of the School Board to avoid this it was decided to place it on property to be acquired adjacent to the school (Figs. 1 and 2) and which will be carried out very shortly. The cost of the building was as per table at end.

Fig. 13. Public School 21, on Mott street, extending through to Elizabeth street, was a problem most difficult of solution since a large portion of the plot was occupied by an old school in which the pupils had to be cared for until a portion of the new structure was made ready, thus making two distinct building operations at a largely increased cost.

There was no place to spare, so the assembly room was placed beneath the courtyard with entrances direct from the street for use by the public at evening lectures.

This does not interfere with the use of the yard for recreation purposes. The cost of the building is as per table at end.

Fig. 14 is one of several school buildings erected under the approach of the Williamsburg Bridge in the endeavor to utilize land already owned by the city in a neighborhood where values range from $10 to

FIGURE 6

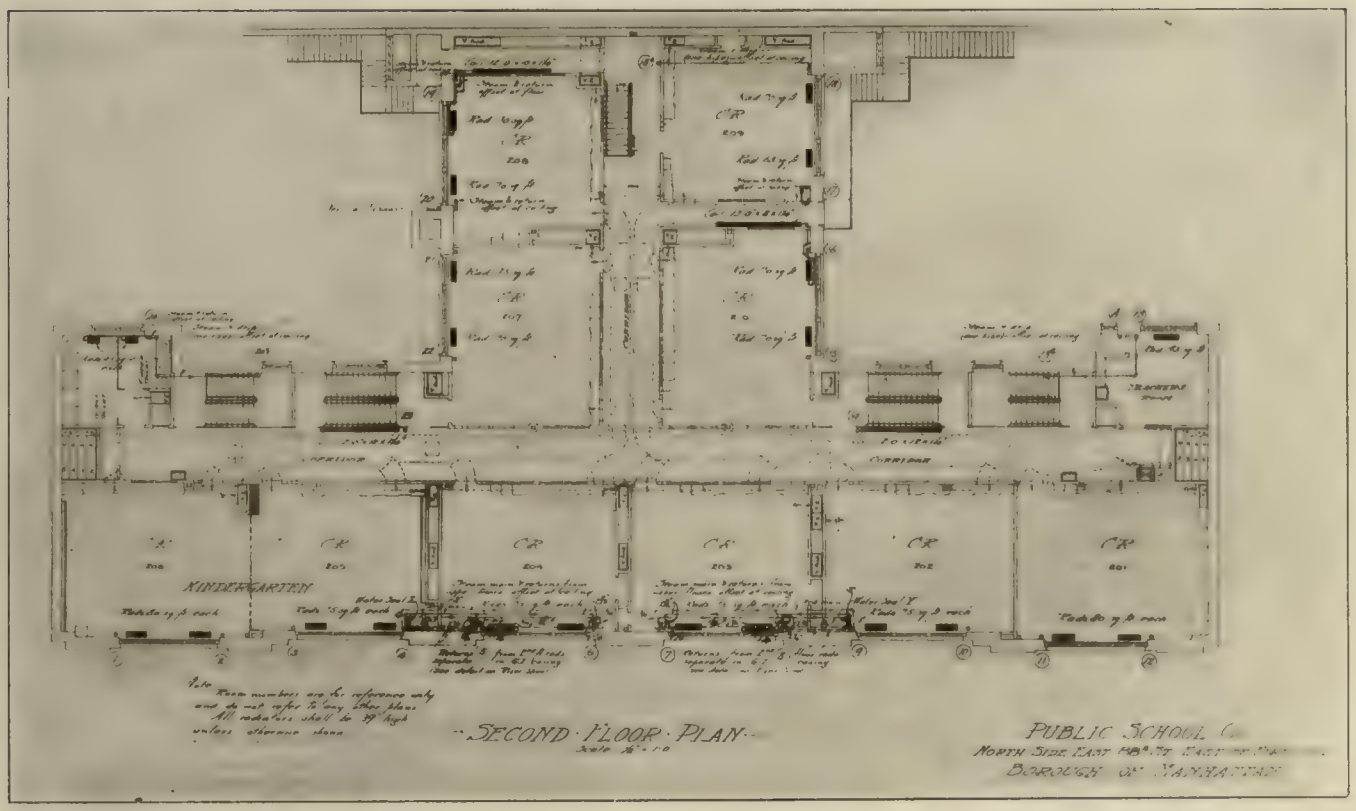


FIGURE 7

$14 per square foot. The noise from the traffic of the bridge, however, is so great that the experiment will scarcely be repeated, although the pupils and teachers have gradually become accustomed to it.

The ventilation of school buildings crowded in upon plots surrounded by towering tenements is rather a complex problem. The many differences in the plans due to the varying size and conditions of school sites requires that a special study of the heating and ventilation shall be made in each case.

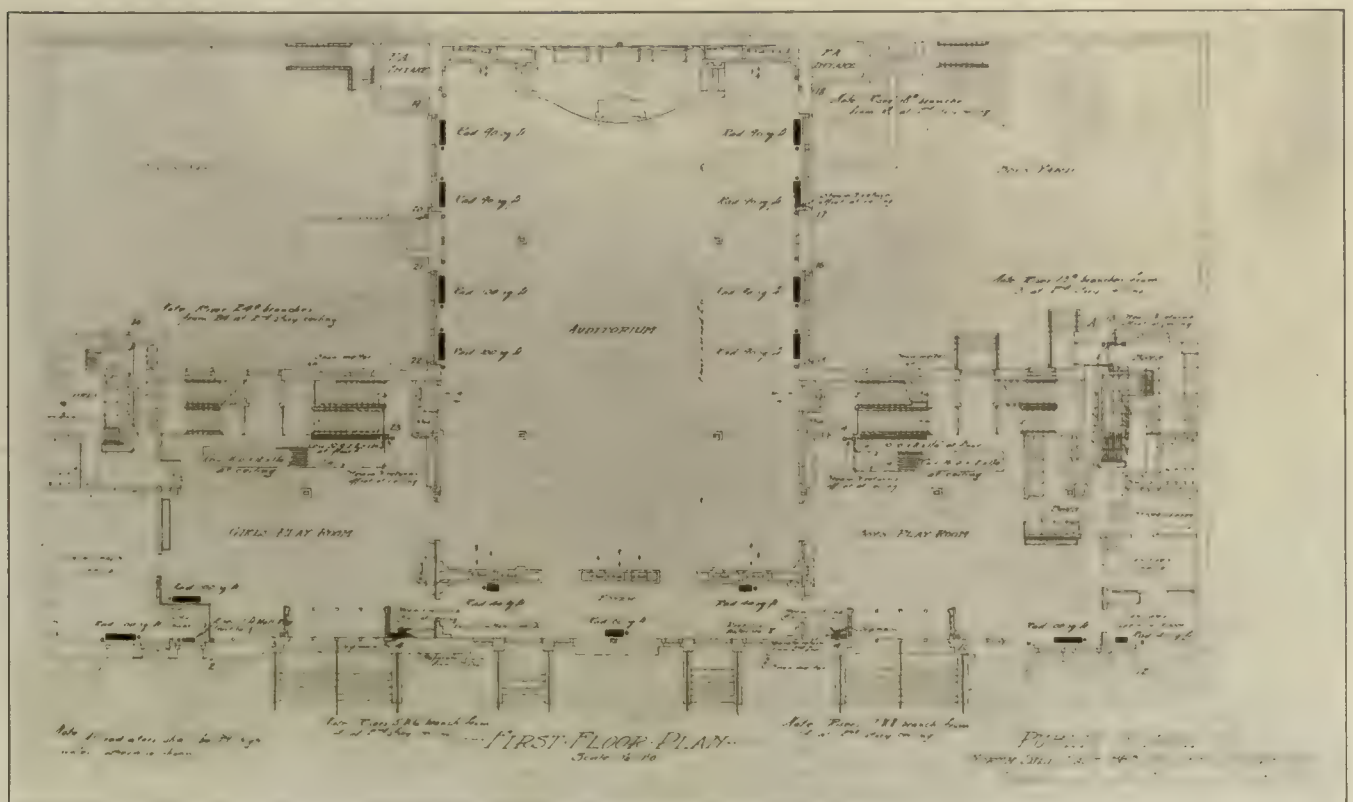


FIGURE 8

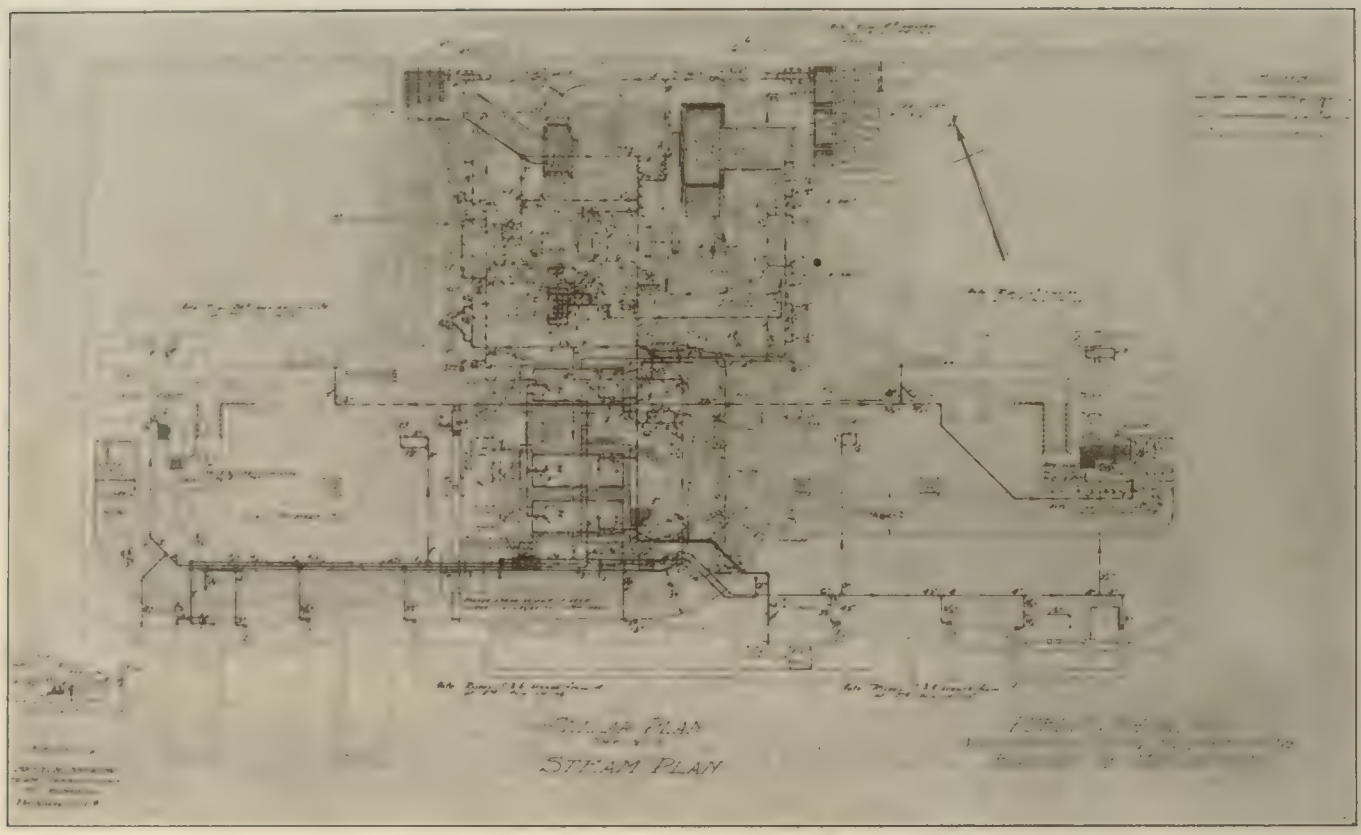


FIGURE 9

One type is shown in Public School 66 in East Eighty-eighth street, near First avenue, Figs. 7 and 8, where a plot 175 feet front by 100 feet in depth (less 5 feet restricted for stoop line) was acquired for a building of thirty classrooms.

The assembly room is placed on the first floor running

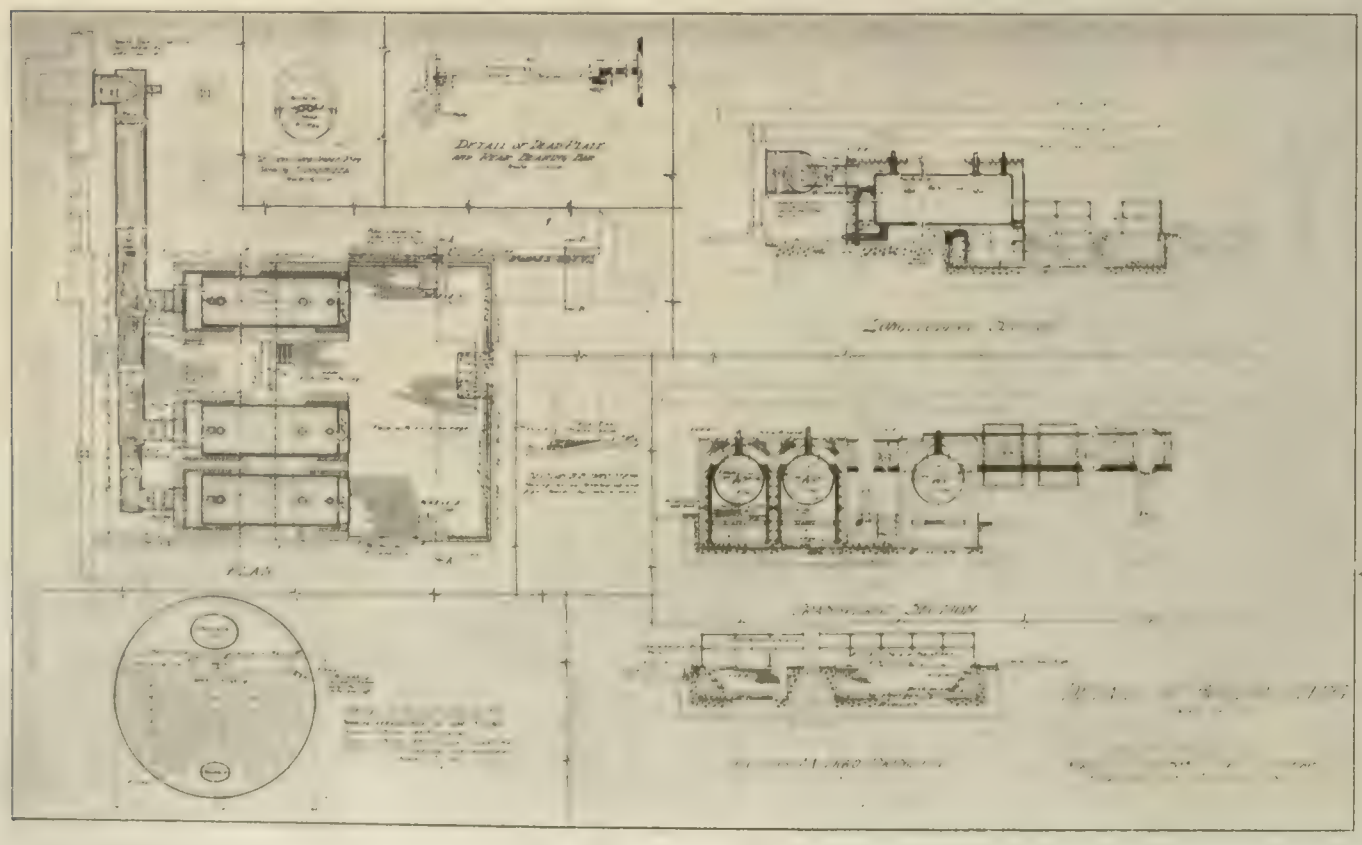


FIGURE 10

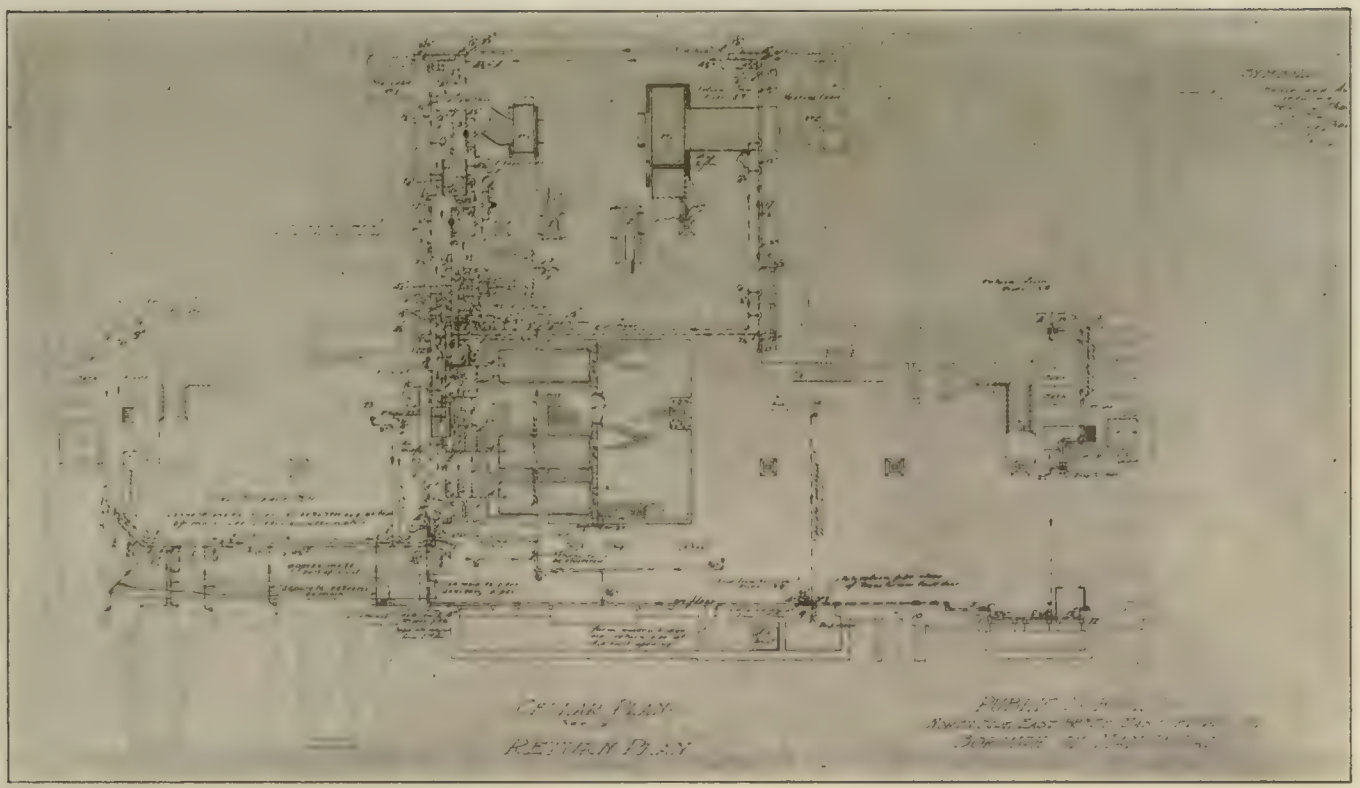


FIGURE 11

through to the rear line, with small indoor playroom for boys and girls. The fresh air intakes are placed at the rear with the openings on the second story window sill level and communicate with the Heating Chambers placed in the cellar directly beneath them, where they pass over the indirect stacks; the temperature is controlled automatically by a thermostat, so that the air passing to the classrooms shall not exceed 72 degrees F.

The fans or blowers are placed near the foot of the heating chambers, and are of such capacity that, running at moderate speed, they will supply 30 cubic feet of fresh air per pupil per minute to each classroom, the air being

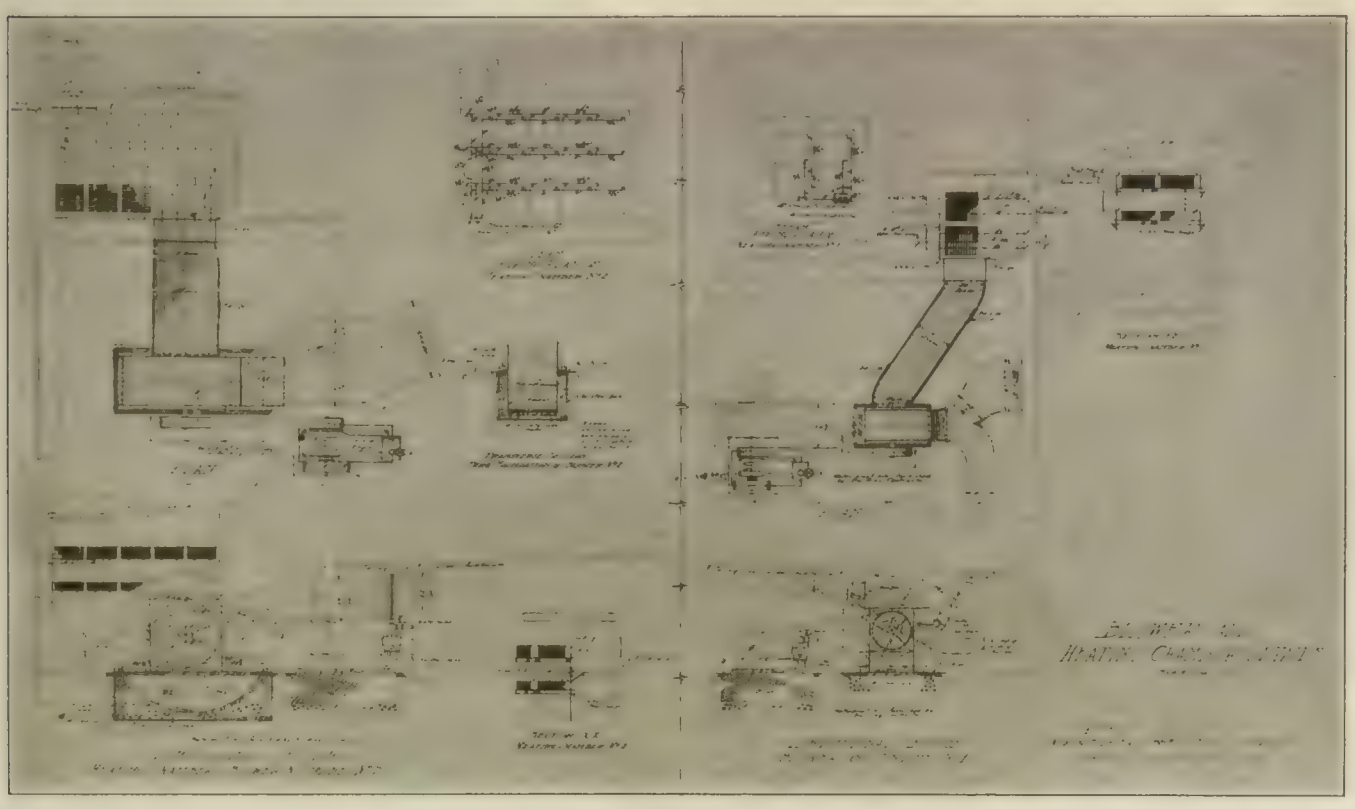


FIGURE 12

conveyed in galvanized iron ducts from the blowers to the various uptake flues leading to the classrooms. Steam for heating and as a motive power for the engines driving the blowers is furnished by a battery of three horizontal tubular boilers located in the cellar, reducing valves being placed in the heating lines.

The steam plan, location of blowers and the ducts leading therefrom are shown in Fig. 9, the steam return plan in Fig. 10. The details of the boilers, their settings and accessories, are shown in Fig. 10, while the blower and heating chamber details are shown in Fig. 12. Each classroom is provided with an independent source of heat by means of radiators placed usually under the windows, automatically controlled so that the temperature of the room may always be maintained at 70 degrees, irrespective of the outside temperature and without superheating the air used for ventilation.

The outlets for the vitiated air are placed within 8 inches of the floor line, both the fresh air inlets and the vent flues being placed in the inner walls of the rooms.

The vents are carried straight through to the roof and finished with an exhaust cowl or hood.

Ample clean-out doors are placed in the flues and heating chambers to permit of their being kept in a cleanly condition.

This method of keeping the heating and the ventilation entirely distinct and separate has been found to give the best results in actual practice, owing to the sudden variations in our climate.

FIGURE 13

FIGURE 14

What is now known as the Borough of Manhattan, but which prior to 1875 constituted the City of New York, is where the congestion of population is greatest and land values consequently higher. There are also points of great congestion, however, in the Boroughs of The Bronx and Brooklyn, where the school buildings must follow the lines already indicated as having been found necessary to meet the same problem in the Borough of Manhattan. As a rule, however, the schools in these two boroughs, as well as those in Queens and Richmond, have quite large spaces for playgrounds, some plots of 200x200 feet having now only an eight-room building thereon, which later, however, will have to be replaced with larger structures to keep up with the steady growth of population.

Public School 37, The Bronx (Plates 94-95), is of the H type, but with the more recent improvement in the planning whereby the assembly room, seating about 1,400, is placed beneath the outdoor playground of the larger court. This has the advantage of obtaining a room free from obstructions and larger than could possibly be formed in the body of the building, while it is easily accessible for the general public. Illumination is obtained by the use of vault lights placed in the pavement overhead and also from windows along the street. Mechanical ventilation and electrical lighting are also provided so that the room may be used under any and all conditions.

The principal disadvantages are the low ceiling—necessary in this particular case because of the presence of water at a high level—and that the children have more stair climbing than usual. This last is overcome almost wholly by so arranging for its use that the pupils enter direct for the exercises before going to their classrooms or just prior to dismissal.

In large schools these assembly rooms have been found so convenient that they are used almost constantly for one purpose or another.

A further development of this scheme has been put into effect in Public School 65, in the Borough of Manhattan, where another and smaller assembly room is formed beneath the small courtyard.

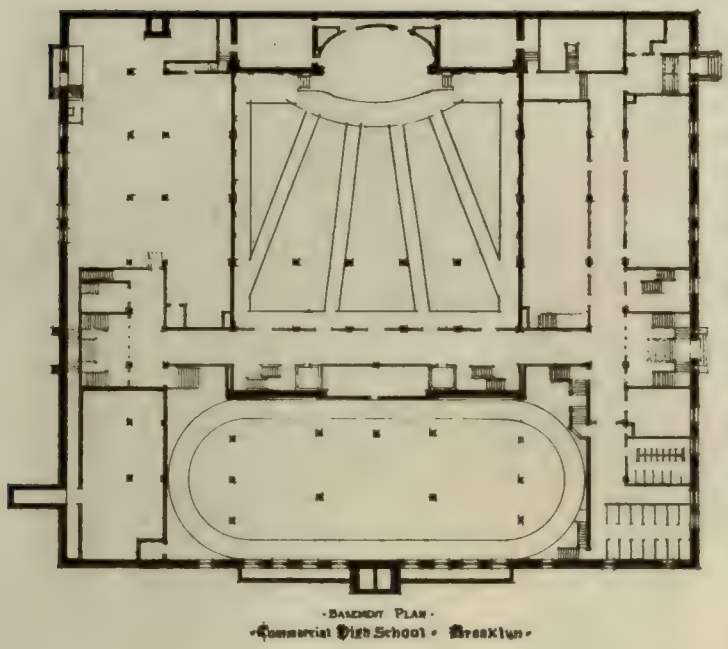


FIG. 15

This was made necessary as the 3,200 pupils which the school accommodates are divided into two separate school organizations.

We have thus a plot of 150 feet frontage by 200 feet in depth to the next street for which a structure has been designed and erected covering the entire area of 30,000 square feet, in the basement of which over half is used for school purposes, while the stories above are so planned as to have courtyards covering about 13,000 square feet for outdoor playground, having an abundance of light and air, which cannot be infringed upon by neighboring buildings.

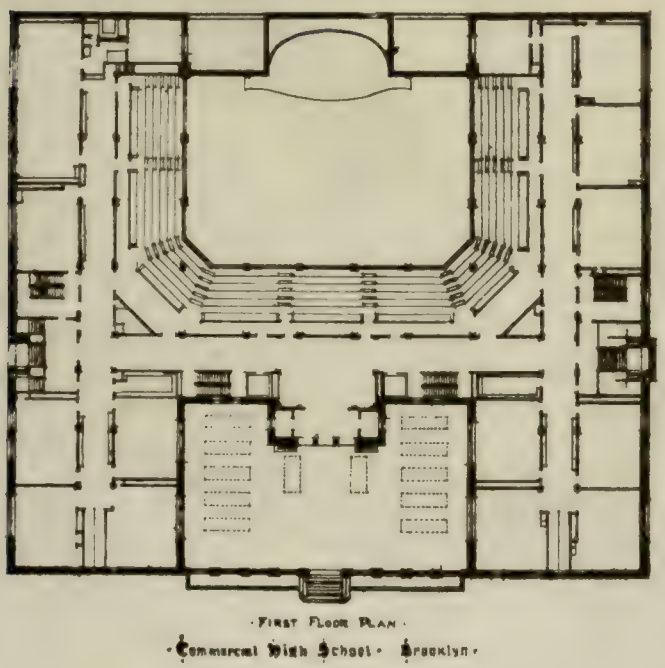


FIG. 16

This also applies to the classrooms which, excepting those in the ends fronting the street of 50 feet in width, all face the courtyard, thus giving much additional light.

Public School 147, Brooklyn, occupies a block front of slightly more than the usual dimensions and somewhat irregular in form.

The assembly room is placed beneath the large court on the rear.

Public School 137, Brooklyn. This is one of several of this type erected about the same time, wherein the toilets and stairways are placed at each end of the building, while the assembly room is formed on the upper floor in the central portion. This is not to be recommended because of the many obvious objections thereto and has been abandoned in all later work.

Public School 153, The Bronx. Erected in a strictly suburban locality at the foot of a sharp slope, the intent having been to bring all down to the curb level.

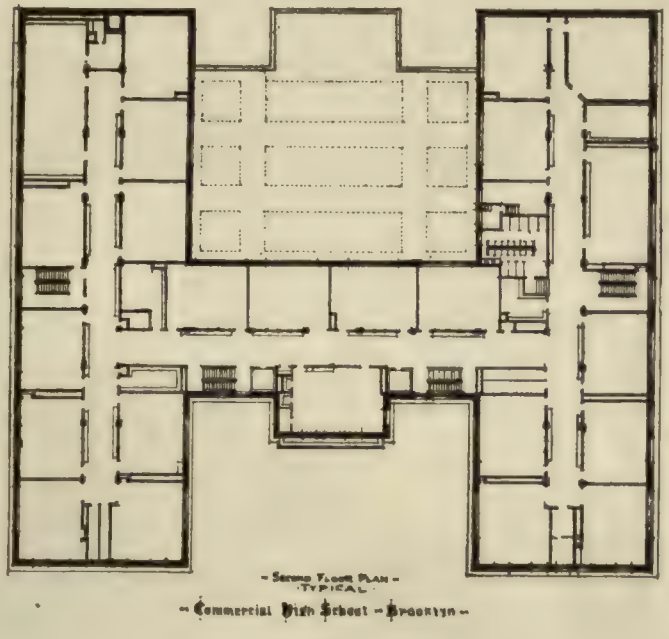


FIG. 17

This was obviated by the adoption of the scheme shown, which left some of the original natural features.

The shrubbery was presented to the school by interested parents and planted at one time without notice to the authorities, who otherwise could have directed the work so as to obtain better landscape effects.

The structure is fireproof throughout and cost about 25 cents per cubic foot, the local conditions as to rock excavations, restrictions and other matters having largely to do with its price.

Public School 34, Richmond. This is another instance where suburban conditions have been met by designing a low building, suited to its location.

As in all similar cases the cost per capita, owing to local conditions, long haulage, great distance from the homes of the workmen, absence of supplies, is greatly in excess of work in the heart of the city.

It might well be added that the expense is increased by the cost of the stoops and approaches, all of which

would answer for a much larger school building, in the computation of which the cost would be inconspicuous, but in the smaller building of eight classrooms becomes of real importance.

The Commercial High School, Brooklyn. This is another instance where the requirements called for a school, the basement of which covers the entire plot of 200x200 feet.

The gymnasium is beneath the front courtyard, and the assembly room, seating some 1,500, in the rear and lighted from above.

Figs. 15, 16 and 17 clearly show the arrangement of the principal floors.

The Curtis High School, Richmond (Plates 87-88). The illustration is somewhat unfortunate, since it does not show the gable end, for, owing to a very sharp descent of the land at the right and obstructions at the left, it is about the only point of view for a camera.

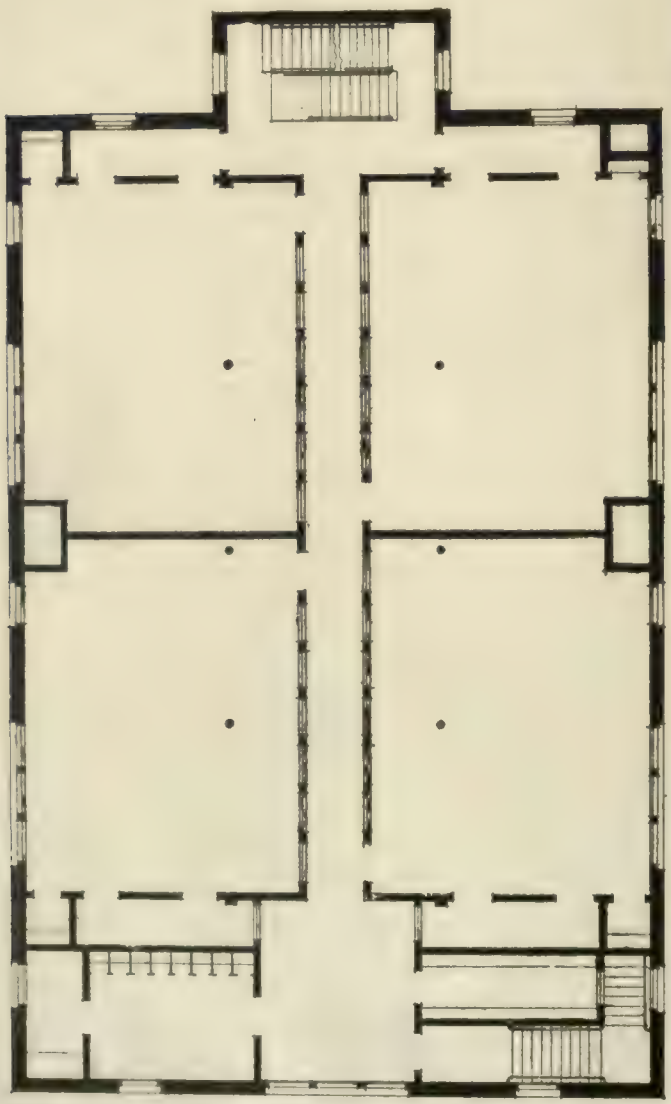


FIG. 18

FIG. 19

The layout of the floors serve to emphasize the statement that the building has never been completed, it having been designed to come within a certain figure, necessitating the omission of the assembly hall planned for the rear of the building on the first floor, the same as the Morris High School.

The gymnasium is therefore used as an assembly hall. The attendance has increased so rapidly that in the near future an addition must be undertaken which will also include the assembly hall.

As the structure is incomplete a statement of cost would be of no value.

The Erasmus Hall High School, Brooklyn, together with its numerous annexes and additions, covers practically the entire plot except a space across the front. Being all of frame construction and nowhere supplying an assembly hall, instructions were received to proceed with a comprehensive plan for the improvement of the whole site, some 250 feet wide by 500 feet in depth, running through from street to street, the first portion of which was to contain a hall, together with a library, certain laboratories, etc., the total cost being limited to a certain sum.

The interior shows also the usual arrangement of platform for all high schools, which is made of sufficient size to accommodate the graduating class, groups of visitors, also for public meetings. The use of scenery or curtains is strictly forbidden, and, in fact, cannot

be used, there being no provision made therefor, and the platform being so designed that a curtain dropped at the rear of the opening would reduce the available area by over one-half, rendering the balance useless.

Public School 33, Richmond, is one of a very few frame buildings erected by the Board of Education during the past few years, and has been designed to serve what is now a sparsely settled community. But such are the rapid changes caused by real estate operations that this building will have to be moved to one side and a large brick structure put in its place. Perhaps this may be deferred several years. This two-classroom building represents the smallest of all the schools we have built.

Thus again local conditions become the factor of greatest control, and when these change almost year by year the problem becomes more and more complex and difficult of solution.

Figure 19, terra-cotta ornament, is placed on each new school-house.

Tables of Cost

School 37, Borough Bronx. Year 1903.

Total accommodation, 2,450. Number classroom units, 53. Cubic contents, 1,566,300 cubic feet. Cubic feet per classroom unit, 29,553. Area second floor, 17,990. Area classrooms, second floor, 10,620, equals 59 per cent.

Various Contracts	Contract Price	Per Cent. Total Cost	Cost per Cu. Ft	Cost per Pupil	Cost per C. R.
Building	$359,025	.842	$0.229	$146.54	$6,774.06
Heating	36,900	.087	.024	15.06	696.22
Sanitary	18,755	.044	.012	7.65	353.87
Electric	11,488	.027	.007	4.69	216.75
Totals	$426,168	1.000	$0.272	$173.94	$8,040.90

Remarks.—First story indoor playroom; auditorium under large courtyard; 4 units devoted to offices, shop and cooking. Pile foundations; quicksand. High-water level.

School 147, Borough Brooklyn. Year 1904-1905.

Total accommodation, 3,950. Number classrooms, 83. Cubic contents, 2,415,389. Cubic feet per classrooms, 303,819. Area second floor, 28,957. Area classrooms, second floor, 171,604.

Various Contracts	Contract Price	Per Cent. Total Cost	Cost per Cu. Ft	Cost per Pupil	Cost per C. R.
Building	$417,745	.796	$0.172	$107.1	$5,221.8
Heating	49,267	.094	.020	12.6	615.8
Sanitary	36,142	.070	.015	9.3	451.8
Electric	21,885	.040	.009	5.6	273.5
Totals	$525,039	1.000	$0.216	$134.6	$6,562.9

Remarks—Flat roof.

School 137, Borough Brooklyn. Year 1901.

Total accommodation, 1,300. Number classroom units, 35. Cubic contents, 835,300. Cubic feet per classroom unit, 23,866. Area second floor, 9,715. Area classrooms, second floor, 5,511, cquals 56.7 per cent.

Various Contracts	Contract Price	Per Cent. Total Cost	Cost per Cu. Ft.	Cost per Pupil	Cost per C. R.
Building	$152,729	.812	$0.183	$117.48	$4,363.69
Heating	18,568	.099	.022	14.28	530.51
Sanitary	12,700	.067	.015	9.77	362.86
Electric	4,211	.022	.005	3.24	120.31
Totals	$188,208	1.000	$0.225	$144.77	$5,377.37

Remarks.—No cellar. Boilers in basement.

Units devoted to offices	1
" " " assembly not subdivided	6
" " " gymnasium not subdivided	2
Total units not providing accommodations	9

School 34, Borough Richmond. Year 1903.

Total accommodation, 400. Number classroom units, 8½. Cubic contents, 214,900. Cubic feet per classroom unit, 25,282. Area second floor, 4,860. Area classrooms, second floor, 2,850, equals 58.6 per cent.

Various Contracts	Contract Price	Per Cent. Total Cost	Cost per Cu. Ft.	Cost per Pupil	Cost per C. R.
Building	$58,010	.828	$0.269	$145.02	$10,547.27
Heating	5,683	.081	.027	14.21	1,033.27
Sanitary	4,187	.060	.019	10.47	761.27
Electric	2,185	.031	.011	5.46	397.27
Totals	$70,065	1.000	$0.326	$175.16	$12,739.08

Remarks.—Boilers, toilets and playrooms in basement. ½ unit devoted to offices.

Commercial High School, Borough Brooklyn. Years 1904-1907.

Total accommodation, 2,669. Number working units, 102. Cubic contents 2,543,110. Cubic feet per unit, 24,989. Area second floor, 27,160. Area classrooms, second floor, 16,582, equals 61 per cent.

Various Contracts	Contract Price	Per Cent. Total Cost	Cost per Cu. Ft.	Cost per Pupil	Cost per C. R.
Building	$453,000	.805	$0.177	$127.6	$6,040.00
Heating	44,693	.079	.018	12.6	595.90
Sanitary	35,311	.063	.014	9.9	470.80
Electric	29,628	.053	.012	8.4	395.00
Totals	$562,632	1.000	$0.221	$158.5	$7,501.70

Remarks.—Basement covers entire site.

School No. 3, Borough Manhattan. Year 1905-1906.

Total accommodation, 2,300. Cubic contents, 1,151,620. Area second floor, 12,794.

Number classrooms, 49. Cubic feet per classroom, 22,581. Area classrooms, second floor, 7,431.

Various Contracts	Contract Price	Per Cent. Total Cost	Cost Per Cubic Foot	Cost Per Pupil	Cost Per Classroom
Building	$229,000	.77	.198	$99.56	$4,673.35
Heating	31,859	.11	.028	13.85	650.18
Sanitary	29,434	.095	.025	12.80	600.07
Electric	7,650	.025	.007	3.33	156.21
Totals	$297,943	1.000	.258	$129.54	$6,080.21

Remarks.—Assembly room yet to be built on property recently acquired at the left.

School 21 (Old No. 106), Borough Manhattan. Year 1903.

Total accommodation, 2,350. Cubic contents, 1,632,780. Area second floor, 15,566.

Number classrooms, 60. Cubic feet per classroom, 27,213. Area classrooms, second floor, 8,162, equals 52.4 per cent.

Various Contracts	Contract Price	Per Cent. Total Cost	Cost Per Cubic Foot	Cost Per Pupil	Cost Per Classroom
Building	$338,000	.805	.207	$143.81	$5,633.34
Heating	38,560	.092	.024	16.41	642.67
Sanitary	28,976	.069	.017	12.33	482.93
Electric	14,440	.034	.009	6.14	240.66
Totals	$419,976	1.000	.257	$178.71	$6,999.60

Remarks—Built in two sections under one contract. Auditorium extension, baths and lockers in basement. Thirteen units devoted to offices, baths, lockers, shop and cooking.

School 31 (Old No. 167), Borough Bronx. Year 1908.

Total accommodation, 1,500. Cubic contents, 922,470. Area second floor 11,415.

Number classrooms, 42. Cubic feet per classroom, 21,963.6. Area classrooms, second floor, 6,220, equals 54.5 per cent.

Various Contracts	Contract Price	Per Cent. Total Cost	Cost Per Cubic Foot	Cost Per Pupil	Cost Per Classroom
Building and sanitary	$208,929	.87	.226	$139.28	$4,974.50
Heating and Electric	30,880	.13	.033	20.59	735.24
Totals	$230,809	1.00	.259	$159.87	$5,709.74

Remarks.—First floor all playroom except ½ unit—12 units devoted to shop, modeling rooms, lockers, gymnasium and offices. Toilets in yard 31,500 cubic feet.

INTERCOMMUNICATING TELEPHONES IN THE MODERN SCHOOL HOUSE

MUCH has been written in recent years bearing on the subject of invention, its progress and its effect upon the civilization of the world. It is generally conceded that new industries have been developed, commerce and trade have been immeasurably increased, and, in fact, that our entire mode of life has been revolutionized as a result of the study and experiments of the great inventors of modern times. It would doubtless be difficult to state without fear of contradiction, the one particular invention that has contributed in greatest measure to the present high state of mechanical development, but probably the telephone would have many advocates in any debate attempting to determine this question. Certainly the modern methods of business with the ever-increasing tendency toward centralization of authority and oversight, make the telephone an indispensable adjunct upon which the efficiency of most organizations largely depends. Wherever a business, operation, or undertaking extends beyond the immediate sight or hearing of its responsible head, the telephone becomes at once a necessity, if the standards of efficiency fixed by leaders in the various fields are to be maintained; and the standards established by the best organizers in business are equally applicable to school organizations.

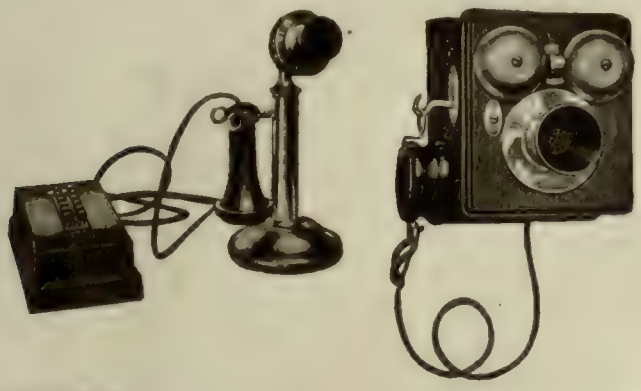
Seated at his office desk, the principal of the modern school has before him a telephone and a key box with parallel rows of buttons and numbered labels. Each teacher in his or her respective classroom has close at hand a telephone. There is also one located in the janitor's room, and one in the stockroom. The administrative head of the school has thus at his finger tips every detail and branch of his organization. Each teacher is secure in the knowledge that the "chief" and the rest of the school faculty are no further away than the telephone instrument on the wall. Such an equipment or some modification of it is known by the trade name of Inter-phone system, which distinguishes the instruments and apparatus from the local and long distance telephones familiar to all. The automatic feature of the Inter-phone system and its adaptability to constant and immediate use, make it particularly appropriate for schools. It performs the same duties as were formerly assigned to messenger boys, signal bells, and speaking tubes, but performs them instantly without inconvenience, confusion, or interruption, and at a minimum of expense. This method of instant and constant communication and inter-connection has come to be considered a necessity in modern schools. No business man would attempt to-day to transact his business without the use of the telephone, and no business man acting on a school board would ask the school principal or teachers to carry on theirs without an equally efficient equipment. Constant supervision and a welding together of the various units of which the school is composed, are absolutely essential to the best results. At the same time there is a feeling of security and responsibility on the part of the teacher who has this dependable telephone constantly at hand.

Considering the practical features of the telephone

PRINCIPAL'S ROOM SHOWING TELEPHONE AND KEY BOX

CLASS ROOM SHOWING LOCATION OF TELEPHONE

equipment we find that the plans for an inter-phone system very readily become a part of the original drawings for a new school building, just the same as the plumbing, heating or electric work. The wiring of the inter-phone system is extremely flexible. A system of conduits and outlet boxes may be laid out so that the wiring for the telephones may be done in conjunction with the other wiring required in the building. Cable is used for this purpose. For inside wiring of non-fireproof school buildings, this may be run in mouldings along walls or be supported by pipe straps. Standard instruments of the wall and desk type are shown in the accompanying illustrations. For the principal's desk,



INTER-PHONES DESK AND WALL TYPES

an ordinary desk stand telephone is the standard, and at its side is placed the small metal box with buttons and name plates.

A modification of the system indicated above, is one in which each teacher has a telephone instrument at hand without connecting buttons. With this system, the principal is at every moment within instant call of all classrooms. Each classroom telephone connects directly with the principal's office, and indirectly through this

JANITOR'S ROOM WITH INTERCOMMUNICATING TELEPHONE

master station with all the other stations in the system. The advantage claimed for this type of installation is that it furnishes intercommunication which is at all times under the supervision of the principal. In the ordinary equipment, one button is mounted on the face of each wall set and on the key box at the side of each desk set, for each station connected with the inter-phone system. The name plate is provided opposite each button, designating the name or location of the station associated with that button. To make a call, it is necessary only to press the button opposite the name of the station desired. This simple act of pressing the button and lifting the receiver signals the party and conversation is carried on exactly as in the case of the ordinary familiar telephone. Nothing simpler than the operation of this device can be imagined.

ARCHITECTURAL TERRA COTTA IN SCHOOL HOUSE CONSTRUCTION

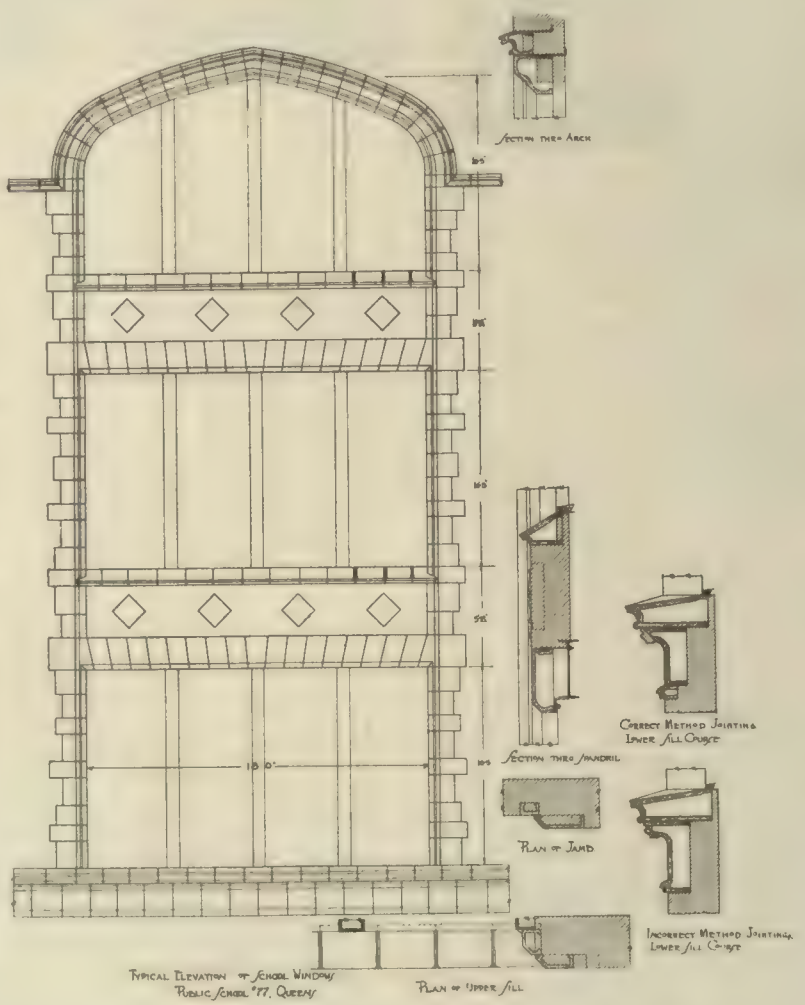
By CHARLES U. THRALL

PUBLIC School No. 77, Borough of Queens, Brooklyn, N. Y., is an excellent example of the use of architectural terra cotta in a modern school building. The architect is C. B. J. Snyder. The building is as typical as a modern building of a class in process of evolution can be.

Broadly speaking, the style of architecture may be termed an adaptation of the Gothic or the Tudor period. The dominant characteristic is the window grouping, a feature of the greatest practical importance in a building where good light is so absolutely essential. This method admits of very effective, and at the same time economical, treatment in terra cotta. (See diagram.) The pieces are comparatively small without loss of character—a saving of time in manufacture — and repetition is frequent enough to make the cost proportionately low.

Another architectural feature of advantage is the flat roof. This not only allows the addition of another story in case of future expansion, but serves the present need as a roof garden, and, in crowded districts, makes an excellent playground.

The construction method adopted in the example is the one generally used. The basement story is made of plain stone in pieces larger than could be conveniently made in terra cotta. This gives the desired impression of a solid base, and the stories above as they ascend may be more and more delicately treated in pliant terra cotta. In the case in question the plain surfaces of the imposed stories are of brick; terra cotta would serve equally well, if not to better advantage.


Section thro Arch
Section thro Mandril
Correct Method Jointing Lower Sill Course
Plan of Jamb
Incorrect Method Jointing Lower Sill Course
Typical Elevation of School Window Public School 77, Queens
Plan of Upper Sill

DETAILS OF TERRA-COTTA CONSTRUCTION

The jointing shown in the diagram is typical. Terra cotta, being a ceramic material, is subject in its manufacture to a slightly variable shrinkage. On this account it is well for the architect to take up the matter of jointing with the terra cotta manufacturer.

In the building illustrated a soft gray terra cotta is used as being consistent with the style of architecture. In some instances it will be found more practical to use a different color and surface.

In crowded districts where the building space is limited, light courts are essential. A bright, white glazed terra cotta that will reflect the light and remain clean is, in such a case, almost a necessity. No other material will serve as well.

The white glaze is also the ideal material for interior use, particularly in buildings where the basement is used for a winter recreation room. The plain white may be relieved with a polychrome frieze in low relief; no other combination will give such a bright, cheerful effect. Among the advantages of glazed terra cotta are the facts that it is easily cleaned with water, is always sanitary, and never becomes shabby, worn, and in need of renovation.

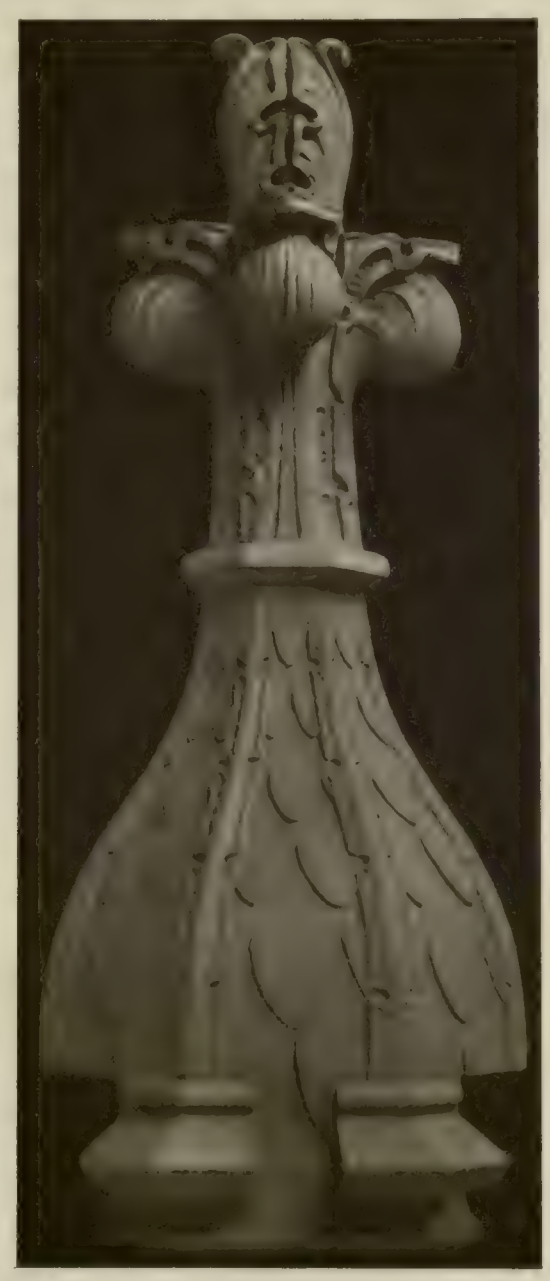
The rapid development of polychrome terra cotta in the past five years gives the architect of to-day unprecedented opportunities for the use of color in permanent form. Public buildings, churches, and schools are particularly adapted for color treatment. It is an effective way to keep such buildings in large cities from seeming insignificance where they are overshadowed by towering

skyscrapers. Examples of polychrome work may be seen in the International Bureau of American Republics, Washington, D. C., Albert Kelsey and Paul Cret, architects; the Boston Opera House (allegorical panels modeled by Bela Pratt), Wheelwright & Haven, architects; the Parkhurst Church, Madison Square, N. Y., McKim, Mead & White, architects; the Academy of Music, Herts & Tallant, architects; the Masonic Temple, Lord & Hewlett, architects, and the St. Ambrose Roman Catholic Church, George H. Streeton, architect, all of Brooklyn, and the Norfolk High School, Norfolk, Va., Neff & Thompson, architects.

The fire resistant quality of terra cotta is one of the strongest arguments—if not the strongest—in favor of its use in school buildings. In the course of manufacture terra cotta undergoes a temperature approximating 2100° F. Fire can sweep over a building of terra cotta and the framework will be uninjured. This quality is of inestimable importance in localities where the possibilities of a general conflagration are great. Such safety could be obtained by the use of no other material excepting brick, and then in less degree.

Economy is another advantage. The saving over stone is said to be from 20 per cent. to 50 per cent., depending upon whether the design is plain or ornamental. In the case of intricate ornament, frequently repeated, the cost of stone is from eight to ten times greater than the cost of terra cotta. Because terra cotta is lighter than stone it is more readily handled, and another saving would result in that the framework could be made materially lighter. The extensive use of terra cotta affects favorably the insurance costs.

Because terra cotta is largely used in the place of stone it must not be mistaken for an imitation. Its fire resistant quality, its adaptability to modeled detail decoration, its wide color range, and its variety of surface treatment—plain, and bright or matte glaze—combine to make it a distinctive material.



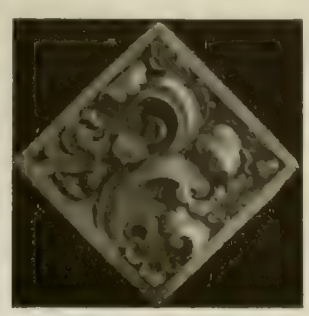
While it may be harmoniously used in connection with stone, brick or concrete construction, it is equally suitable for the entire building from the sidewalk up.

The fact that terra cotta is used for many important public buildings indicates positively that it is a high class material. Its extensive use on the buildings of the College of the City of New York (George B. Post & Sons, architects), in strong contrast with stone, and on the new State Educational Building, at Albany (Palmer & Hornbostel, architects), in direct harmony with marble, are particularly fitting examples in the present connection.

Every school building erected in New York during the past twenty years has used architectural terra cotta, generally to a large extent.

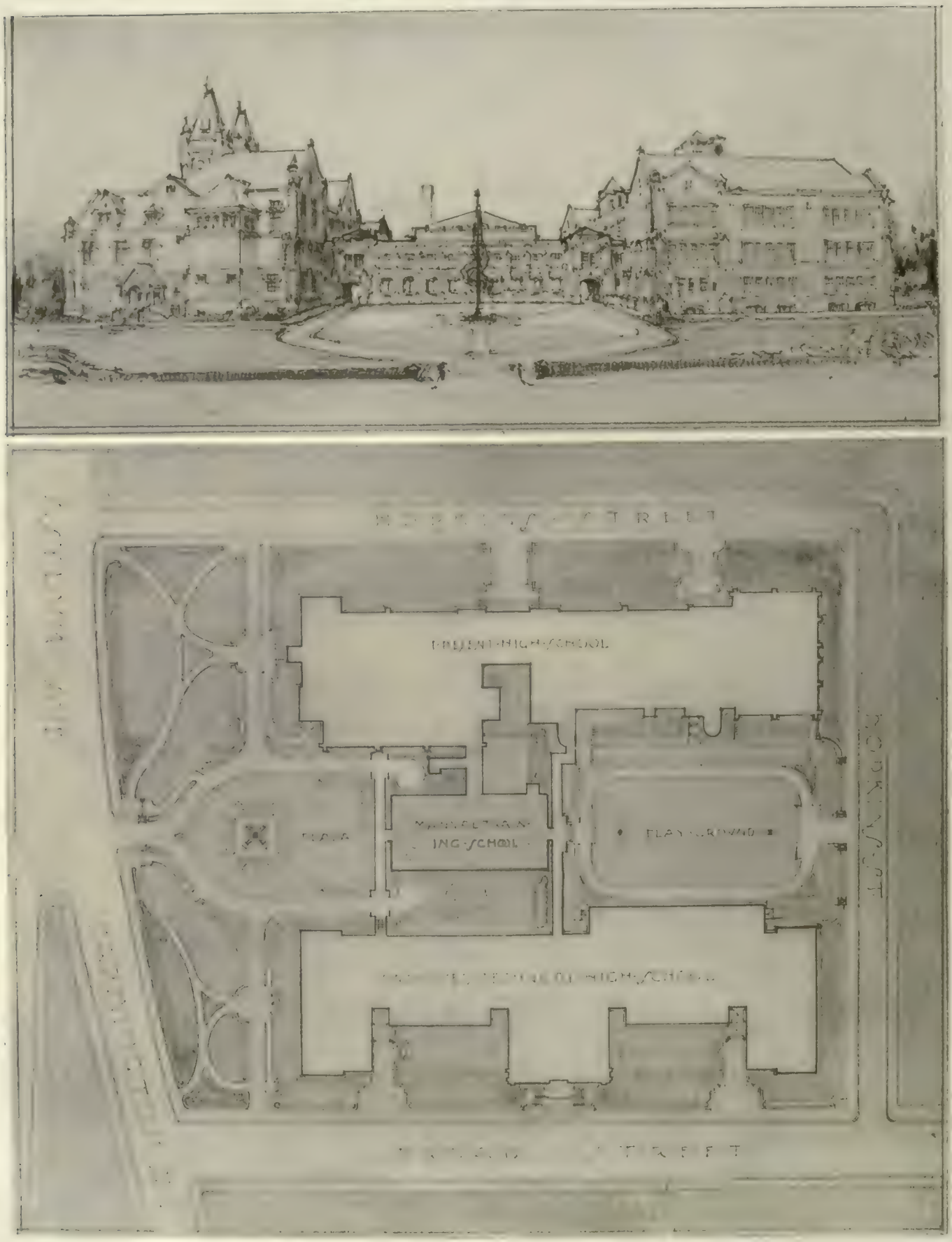
Artificial Lighting of School Houses

In large cities, where, during the winter months, night sessions are held to accommodate certain pupils whose daylight hours are spent in necessary toil, the question of an adequate and harmless system of artificial lighting has received care and thoughtful attention. The ability to illuminate the classroom with a moderate, even light, one that will not dazzle the eye, seems to be best met by incandescent lamps, provided with suitable reflectors. This method, of course, only applies where electricity is used for lighting. Gas, owing to its non-flexibility of adjustment, the heat generated and other reasons, cannot be considered a desirable illuminant for classrooms.



Modern School Houses

Plates

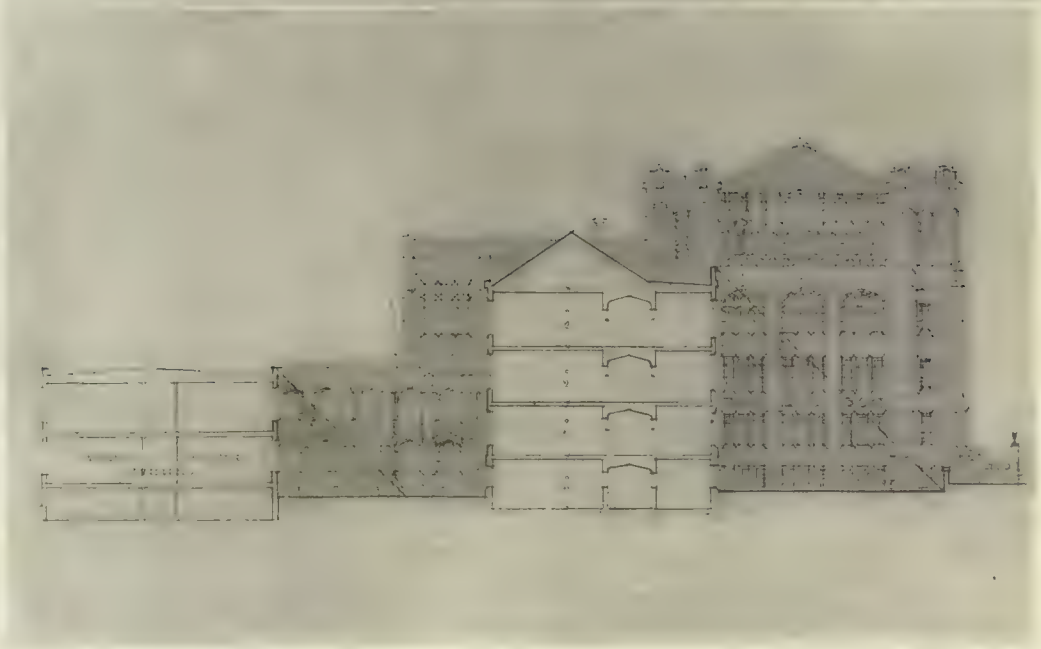


PERSPECTIVE AND BLOCK PLAN

The symmetry of the above plan is commendable. The proposed Technical High School is a practical modern school building, the same length as the present High School and its location serves to screen the Manual Training School, a somewhat incongruous building. The ready intercommunication between the three schools of the group is well provided for.

TECHNICAL HIGH SCHOOL
HARTFORD, CONN.

MESSRS. DAVIS & BROOKS, ARCHITECTS
MESSRS. PALMER & HORNBOSTEL. CONSULTING ARCHITECTS



BROAD STREET ELEVATION AND CROSS SECTION, SHOWING
SIDE ELEVATION OF CENTRAL PAVILION

These plans contemplate a fireproof construction of floors and partitions upon a steel frame with the exterior walls self-supporting, and bearing their share of the weight of the floors. In selecting the exterior materials for this building the architects suggested red brick with a brown sandstone trim, as best harmonizing with the buildings already erected. The cubage of this building is about 3,000,000 cubic feet, and the probable cost, as estimated by Mr. John M. Carrere, professional adviser to the Board, was 20 cents per cubic foot, or $600,000.

TECHNICAL HIGH SCHOOL
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ARCHITECTS

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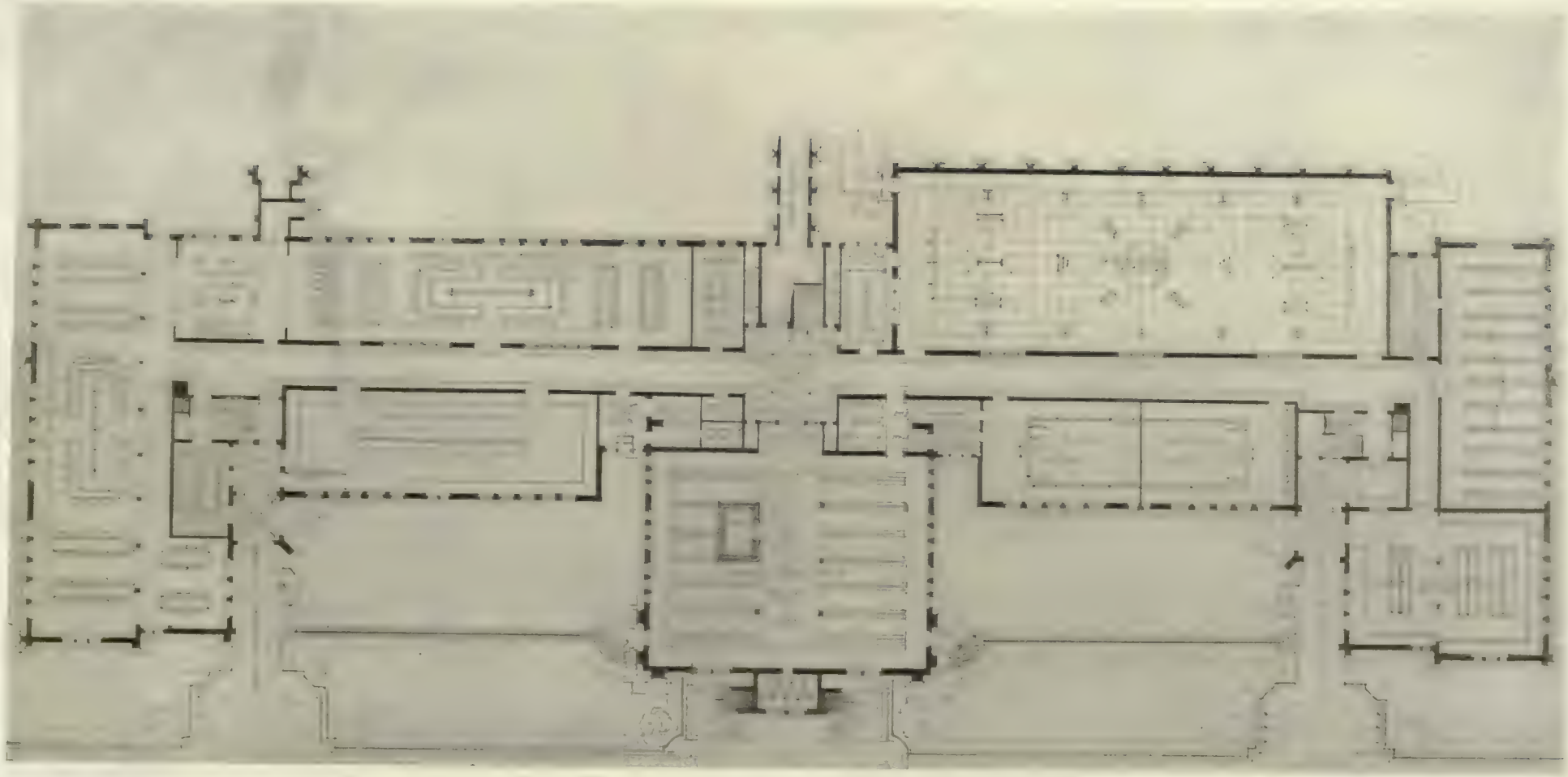
CONSULTING ARCHITECTS



BASEMENT PLAN

Note that the gymnasium occupies all the space facing the playground through the first floor, thus eliminating the noise from all classrooms. The baths and lockers naturally group themselves about the gymnasium, and occupy the south half of the basement.

TECHNICAL HIGH SCHOOL
HARTFORD, CONN.

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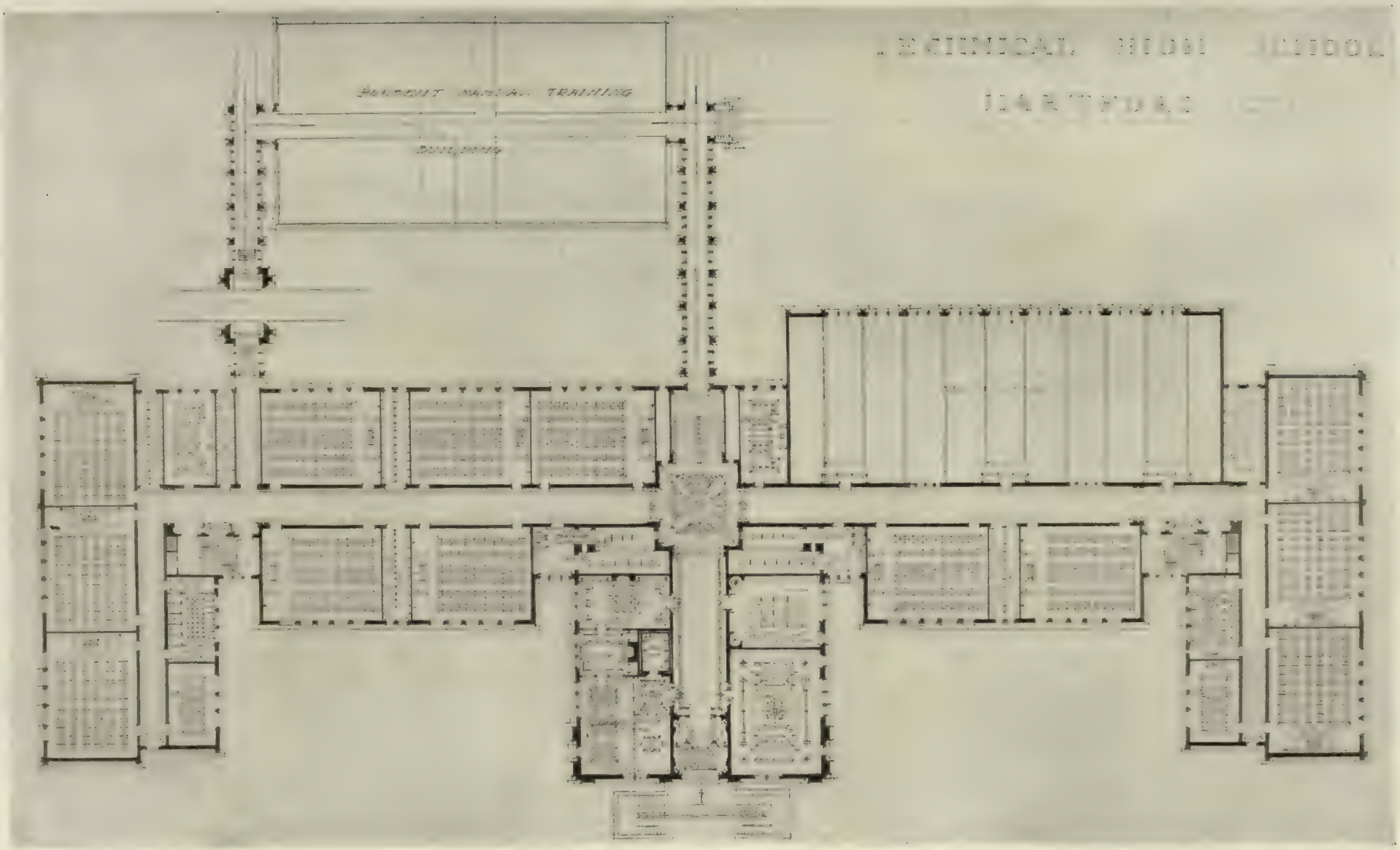

FIRST FLOOR PLAN

The classrooms are uniform throughout the building, 30 x 40 feet, with light from groups of five windows on long side of rooms, furnishing one foot of glass area for six and one-third feet of floor area. The requirements of the programme seem to have been admirably complied with in every essential detail.

TECHNICAL HIGH SCHOOL
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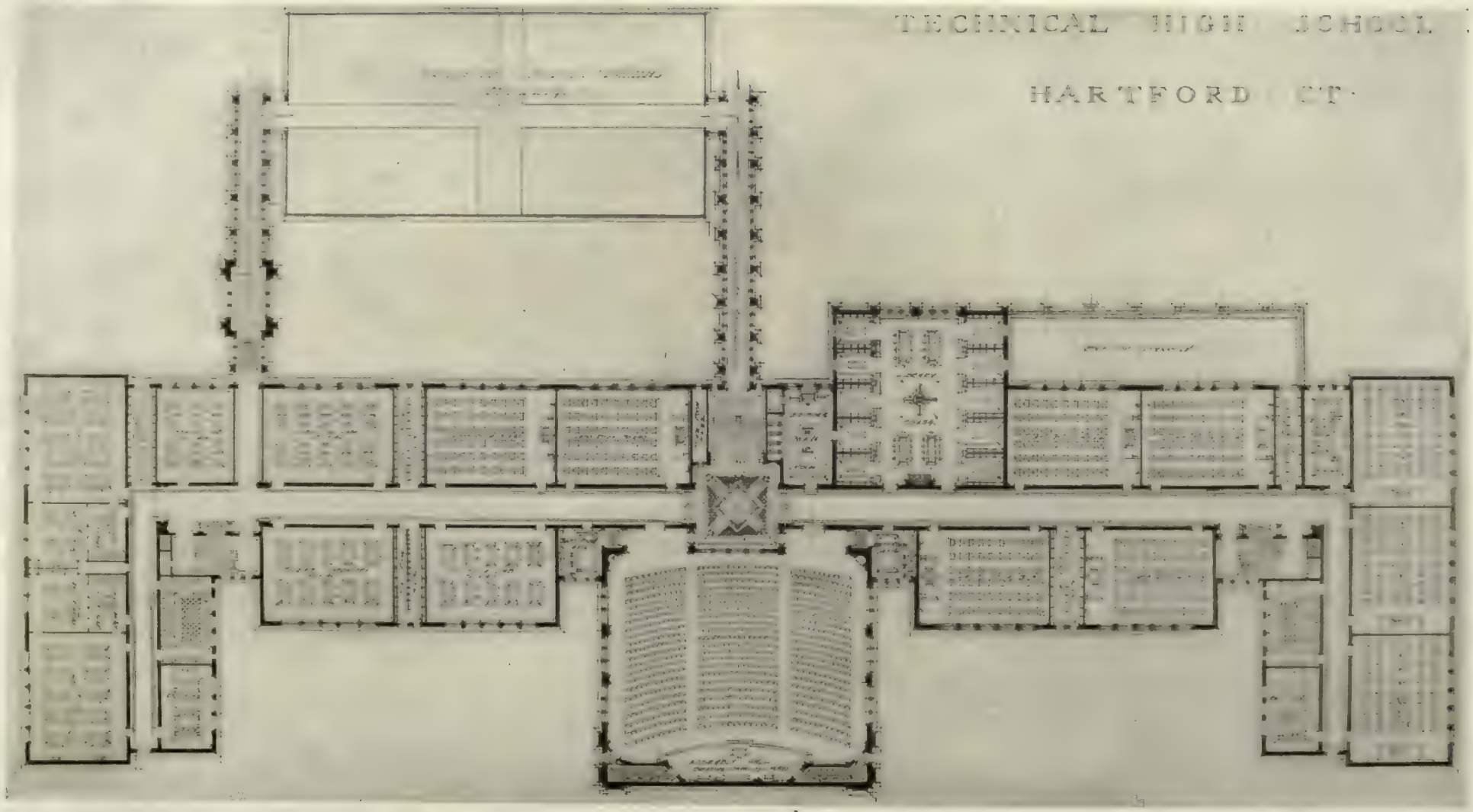

SECOND FLOOR PLAN

In the planning, careful attention has been paid to the grouping of the sexes in their proper ratio, which is established as eight to five. The assembly hall is readily accessible, and is reached by a flight of monumental stairs opposite the central entrance. Other features of the plan are the library and the laboratory group.

TECHNICAL HIGH SCHOOL
HARTFORD, CONN.

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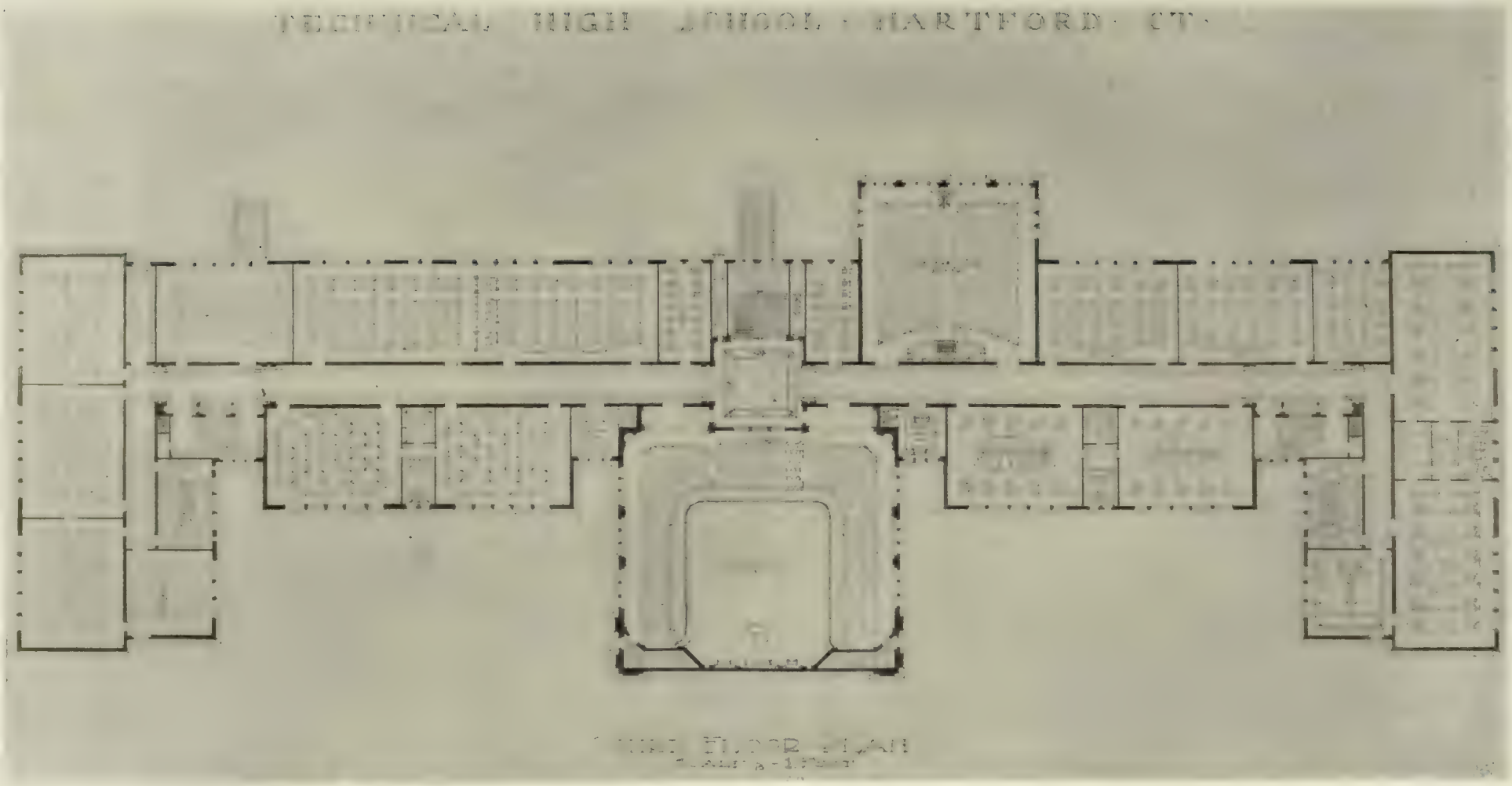

The principal features of the floor are the lecture room, auditorium, and drawing group. The domestic art and science groups are also on this floor. The boys and girls, throughout these various floors, have separate entrances at a central point in their classroom groups. Double interlocking stairways are placed between these entrances and the corridor, so that it is possible to reach any floor directly without crossing the building.

TECHNICAL HIGH SCHOOL
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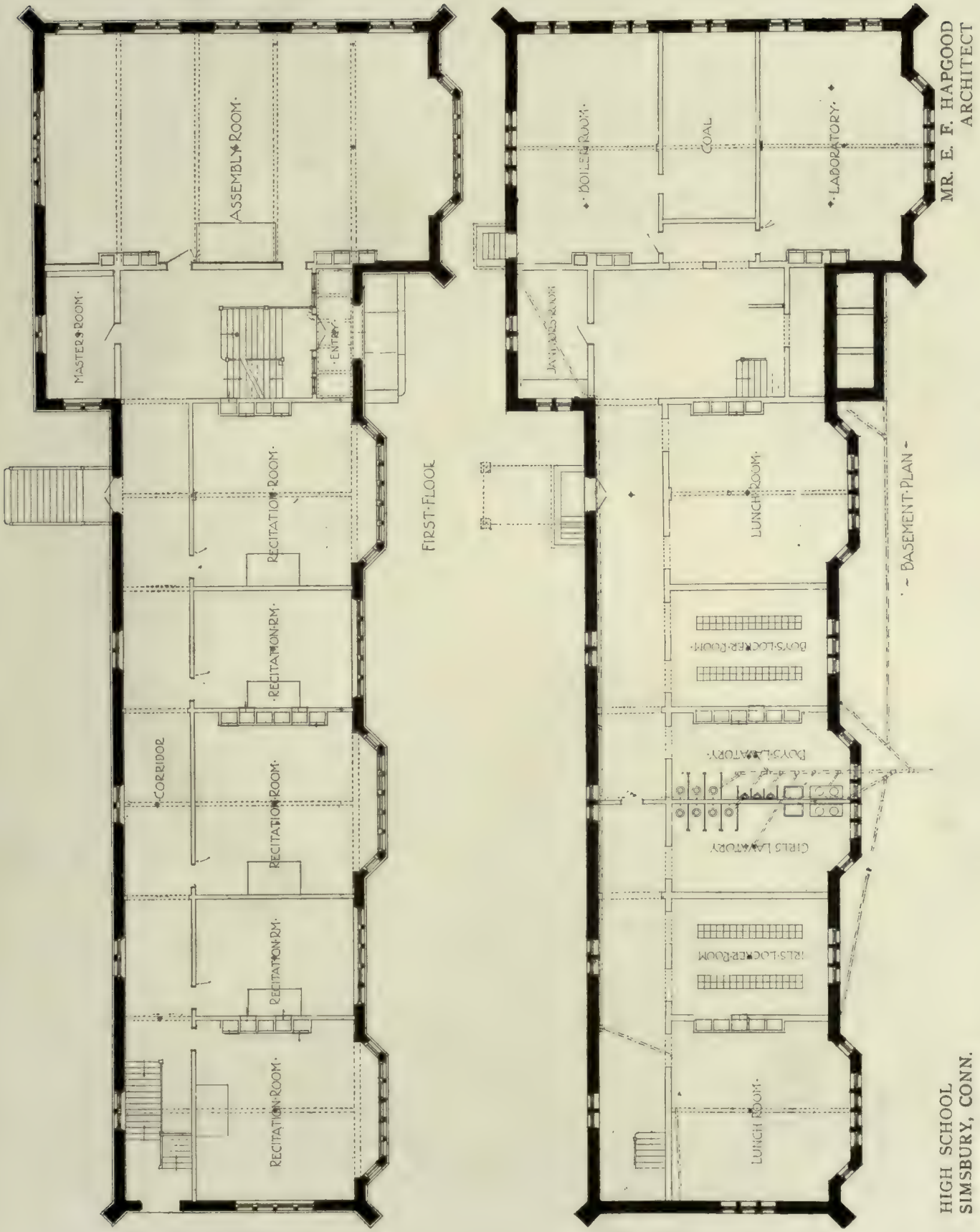
HIGH SCHOOL
SIMSBURY, CONN.

This school is built of local red sandstone with roof of variegated green slate. As the land available was large, and the background a picturesque one, it was determined to make the building practically a one-story school. With the exception of a teachers' retiring room and toilet there is nothing in the second floor, although it has been arranged so that additional recitation rooms may be finished there if desired. Building is heated by usual gravity system.

MR. E. F. HAPGOOD
ARCHITECT



HIGH SCHOOL
SIMSBURY, CONN.

MR. E. F. HAPGOOD
ARCHITECT

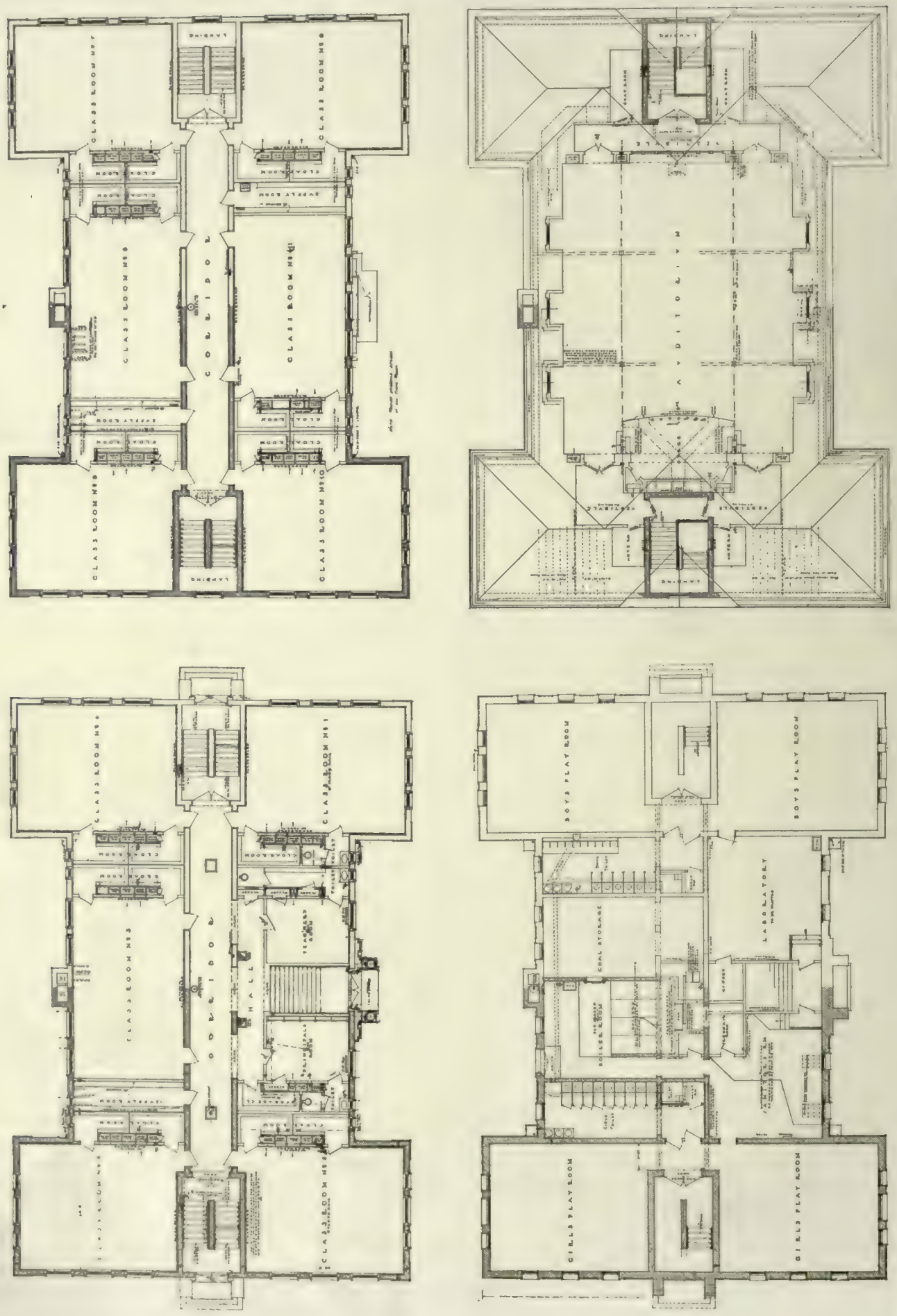
HIGH SCHOOL
SIMSBURY, CONN.

MR. E. F. HAPGOOD
ARCHITECT

PUBLIC SCHOOL
METUCHEN, N. J.

The exterior of this school is built of dark red Clifford brick, laid up with dark wide joints. The water table, sills and lintels of windows, are of cream colored terra-cotta, matte glazed. The main and side entrances are of white pine, painted white, as is also the cornice of building. The roof is of red cedar shingles. Floors are of maple and interior trim of North Carolina pine. The walls are of hard plaster, and the ceilings metal.
Cost, $45,385.10, or 14 3-4 cents per cubic foot.

MESSRS. WALKER & MORRIS
ARCHITECTS



MESSRS. WALKER & MORRIS
ARCHITECTS

PUBLIC SCHOOL
METUCHEN, N. J.

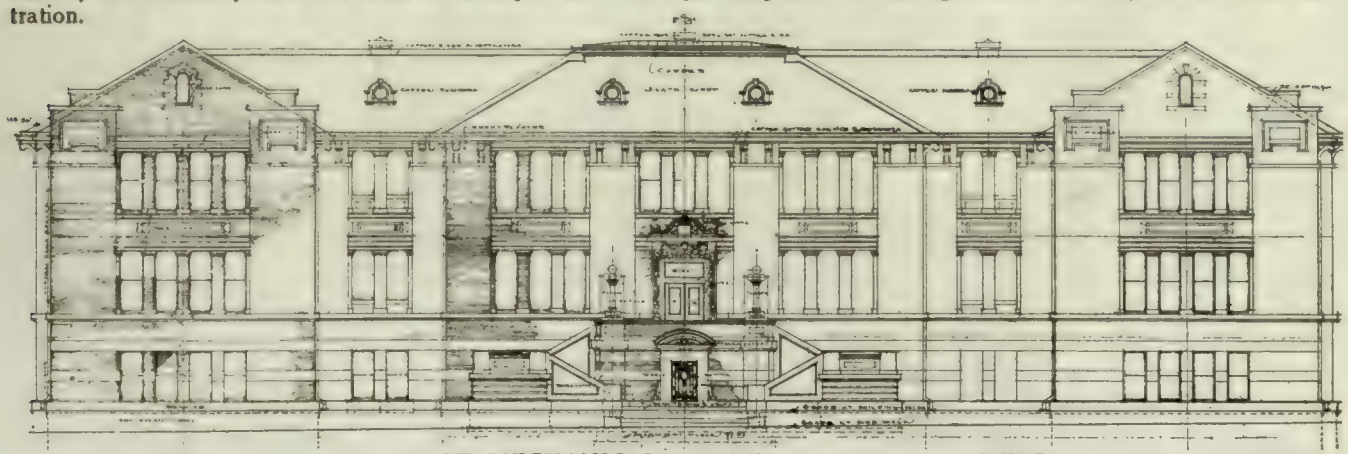
The David Ranken, Jr., School of Mechanical Trades, was founded for the purpose of teaching the Building Trades to young men at a nominal cost, and also with the hope of improving the standard of workmanship among mechanics by affording a means of a more thorough fundamental education, in mechanics, than is possible under prevailing methods.

Study of existing institutions of similar purpose showed well developed methods of instruction, but with inadequate housing. The building problem had therefore to be solved in practically an independent manner by the Architects. The site occupies the half of a city block and is about 450 feet long by 305 feet wide, bisected by a 20-foot public alley, which it is expected will be soon vacated by the city.

The amount of money immediately available for building purposes was limited to about $150,000.00. As it was the desire of the founder to begin building operations immediately with a view to the early inauguration of school work, it was deemed advisable to begin at once the erection of a single building, arranged for immediate requirements, but planned to ultimately become one of a group of connected buildings covering the greater portion of the building site. It was determined to provide at once facilities for the instruction of classes in bricklaying, plastering, carpentry, plumbing and painting, with one other shop room to be used temporarily as an Assembly Hall.

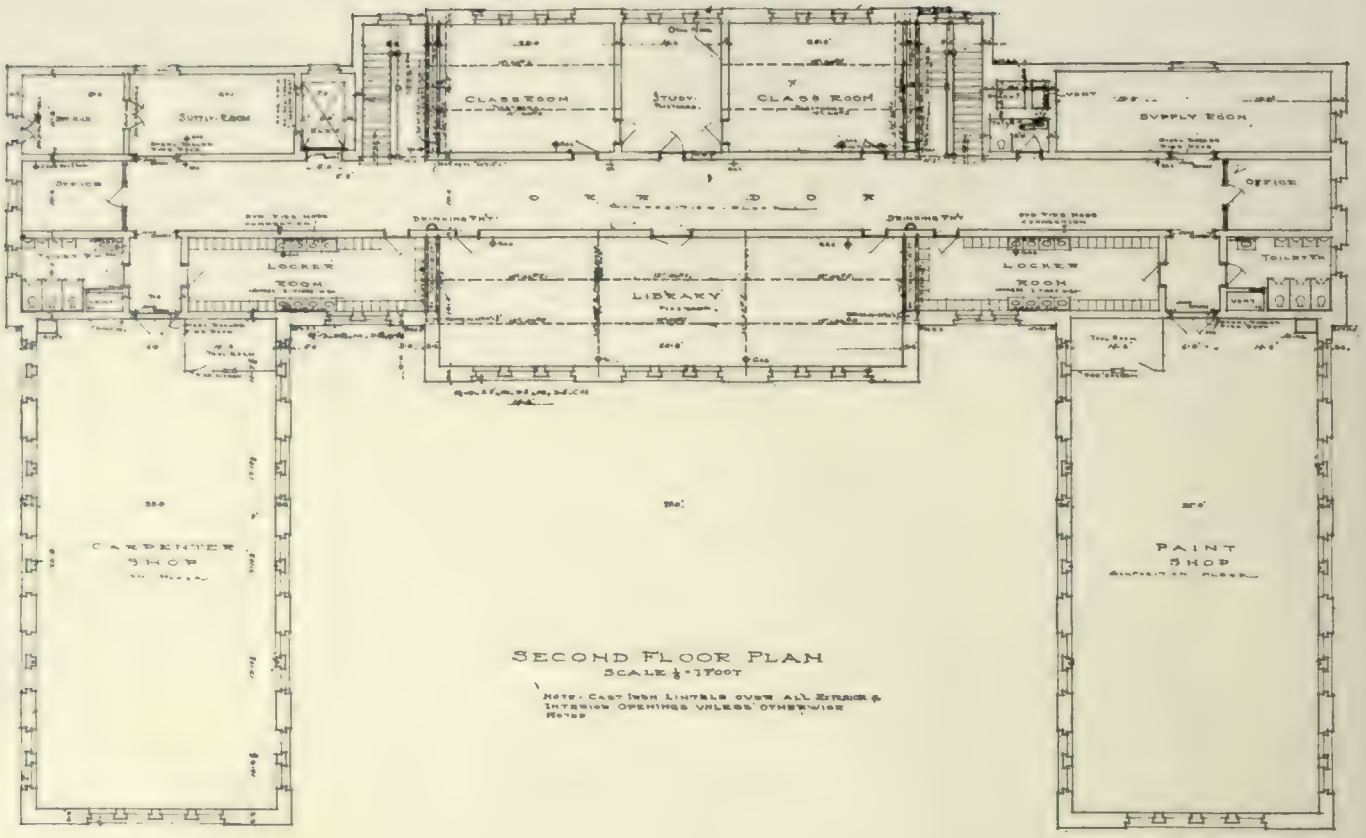
These six shops are contained in two wings of three stories connected by corridor with an Intermediate Building, containing the class rooms and a temporary Administration Office. Each shop is 35' x 70' with light exposure on three sides and separated from the main corridor only by the toilet and locker rooms. Across the corridor and directly back of each shop is a supply room for the storage of various materials for use in shop work. These are directly accessible from the Alley by means of the freight elevator. Part of the supply room assigned to the Carpenter Shop is occupied by a dry kiln for lumber. Except for doors and windows, no combustible material is used in the building, which is made as fireproof as possible. All partitions and walls are of brick. The floors are reinforced concrete with karbolith top finish and sanitary base. The main corridors are finished in light gray brick and the shops in ordinary brick, the only plastering being in the class rooms and offices. The sub-basement contains a heating, lighting and power plant sufficient for the present building, including power for electric motors to run the machinery necessary in the shops. The exterior is of rough brick with terra cotta trimmings, except the frieze, which is of plaster.

It is expected that this School will be greatly extended in the near future by the addition of an Administration Building, Library and Assembly Hall, and much more shop room, but the planning of these buildings is not sufficiently advanced for illustration.



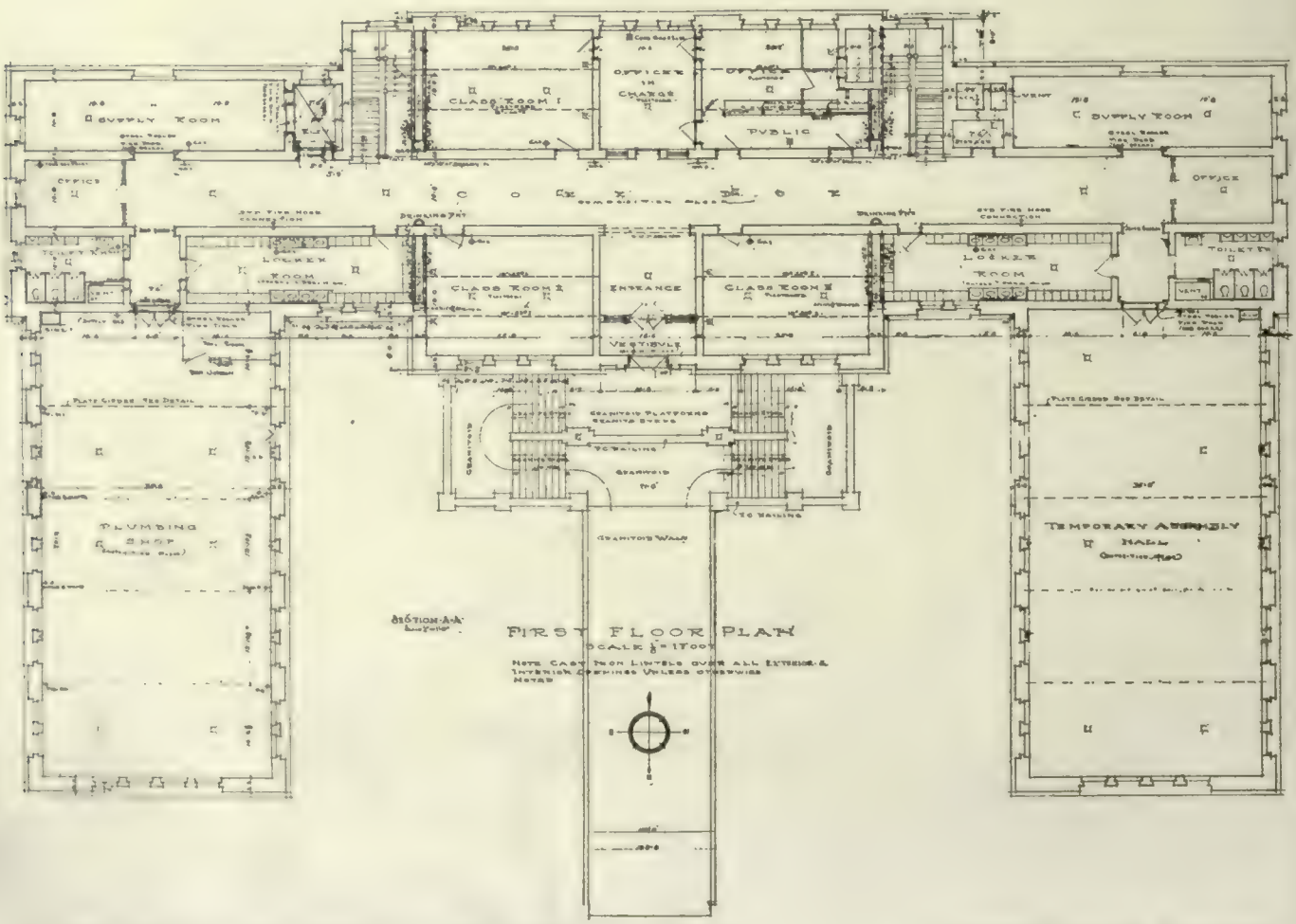
DAVID RANKEN, JR., SCHOOL OF MECHANICAL TRADES
ST. LOUIS, MO.

MESSRS. EAMES & YOUNG
ARCHITECTS



SECOND FLOOR PLAN
SCALE ⅛" = 1'-0"

NOTE - CAST IRON LINTELS OVER ALL EXTERIOR & INTERIOR OPENINGS UNLESS OTHERWISE NOTED

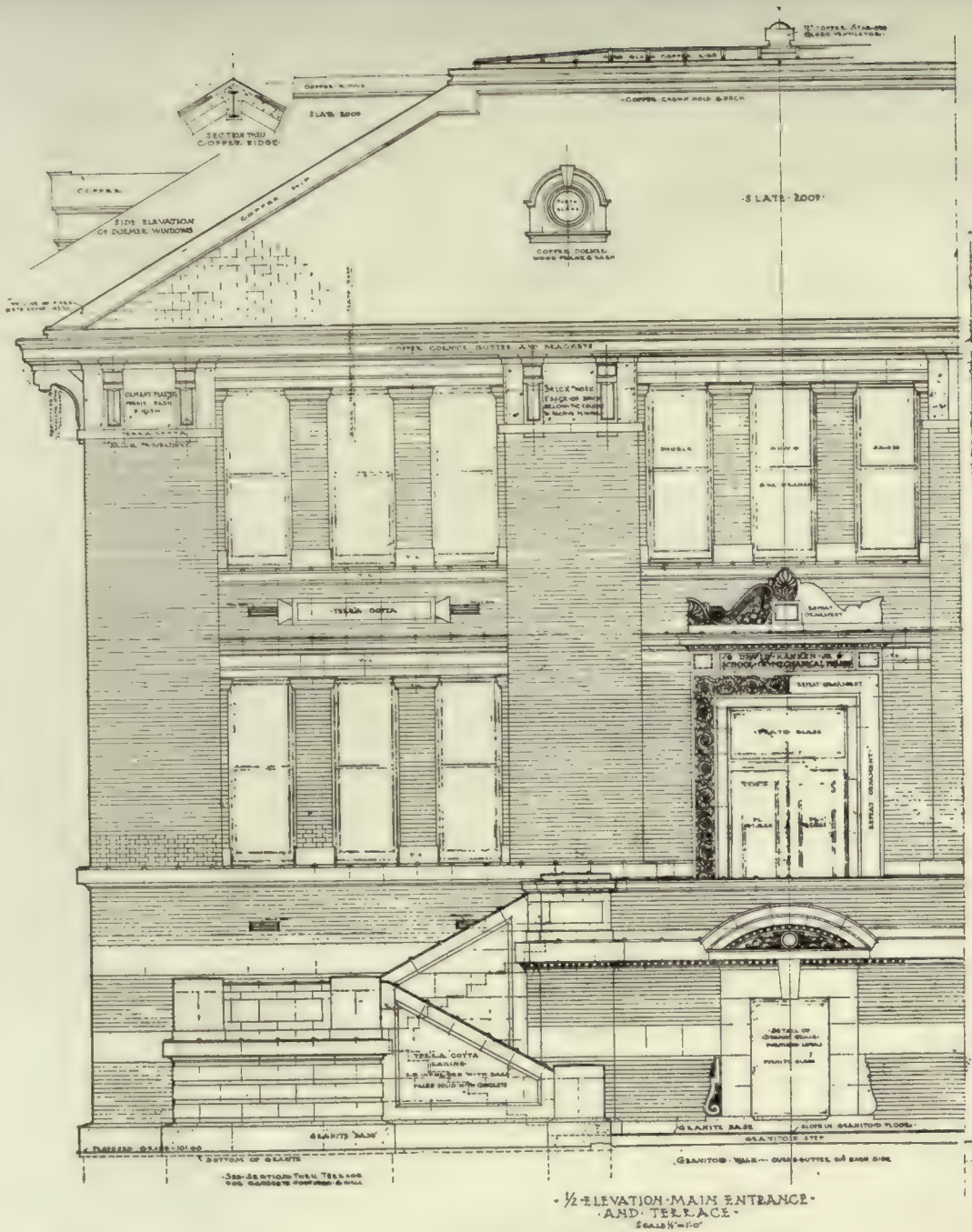


FIRST FLOOR PLAN
SCALE ⅛" = 1'-0"

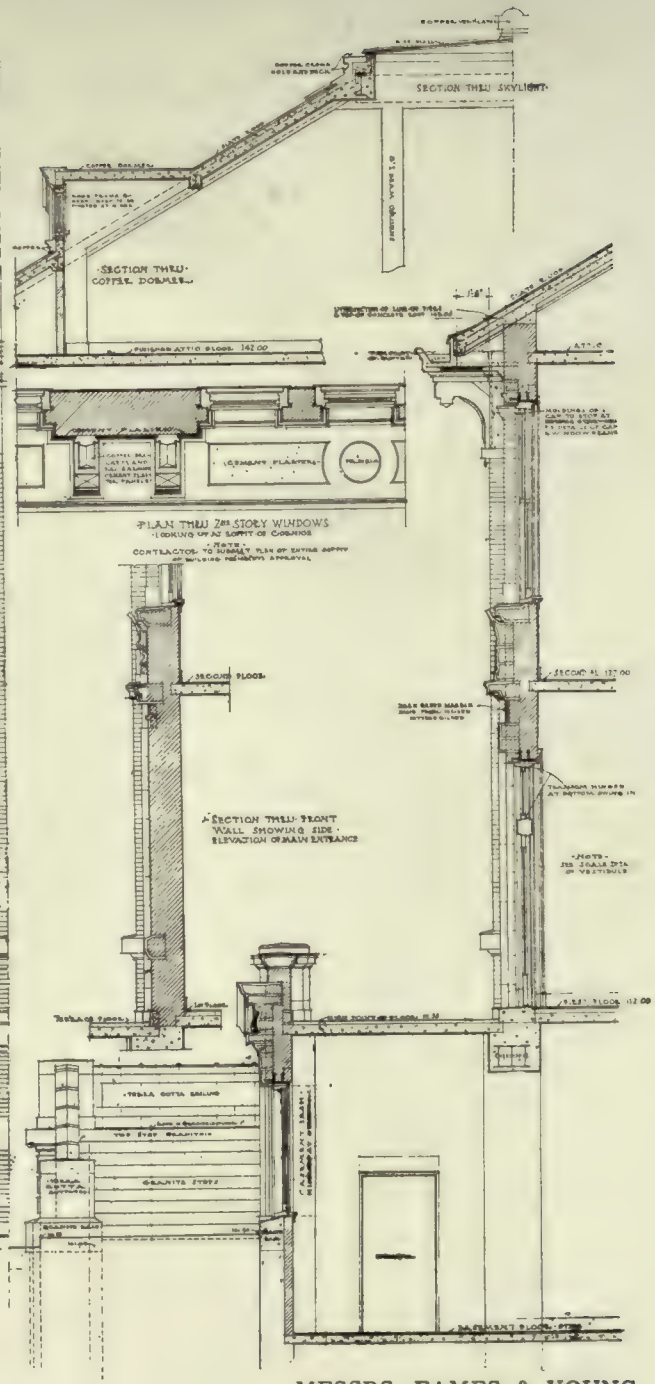
NOTE CAST IRON LINTELS OVER ALL EXTERIOR & INTERIOR OPENINGS UNLESS OTHERWISE NOTED

DAVID RANKEN, JR., SCHOOL OF MECHANICAL TRADES
ST. LOUIS, MO.

MESSRS. EAMES & YOUNG
ARCHITECTS

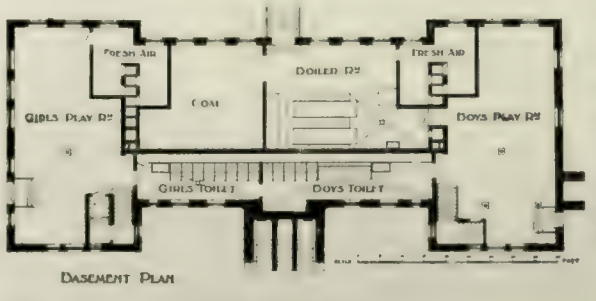


½ ELEVATION MAIN ENTRANCE AND TERRACE
Scale ½"=1'-0"

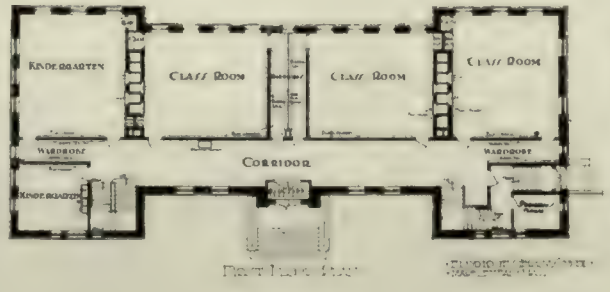

SECTION THRU SKYLIGHT
SECTION THRU COPPER DORMER
PLAN THRU 2ND STORY WINDOWS
SECOND FLOOR
SECTION THRU FRONT WALL SHOWING SIDE ELEVATION OF MAIN ENTRANCE
TERRA COTTA RAILING
GRANITE STEPS

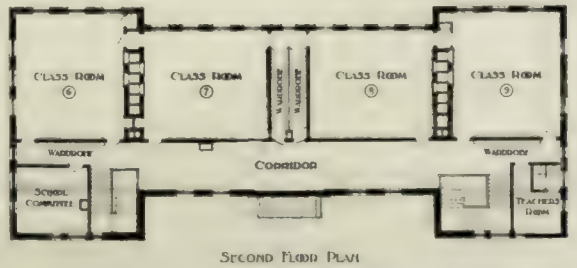
DAVID RANKEN, JR., SCHOOL OF MECHANICAL TRADES
ST. LOUIS, MO.

MESSRS. EAMES & YOUNG
ARCHITECTS



Basement Plan





Second Floor Plan

ELBRIDGE GERRY SCHOOL
MARBLEHEAD, MASS.

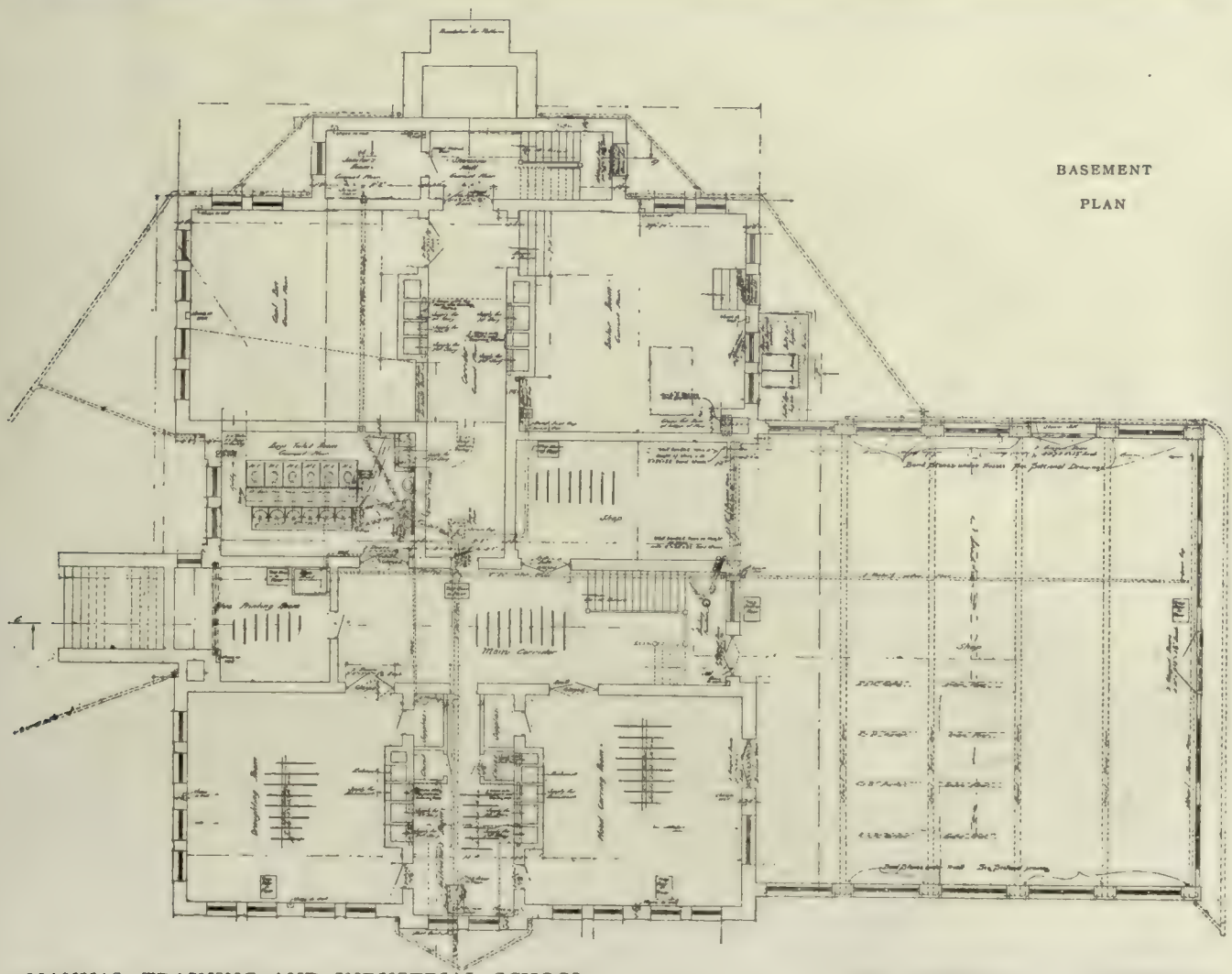
MESSRS. KILHAM & HOPKINS
ARCHITECTS

ELBRIDGE GERRY SCHOOL
MARBLEHEAD, MASS.

MESSRS. KILHAM & HOPKINS
ARCHITECTS

MANUAL TRAINING AND INDUSTRIAL SCHOOL
NEW LONDON, CONN.

MR. DUDLEY ST. C. DONNELLY
ARCHITECT



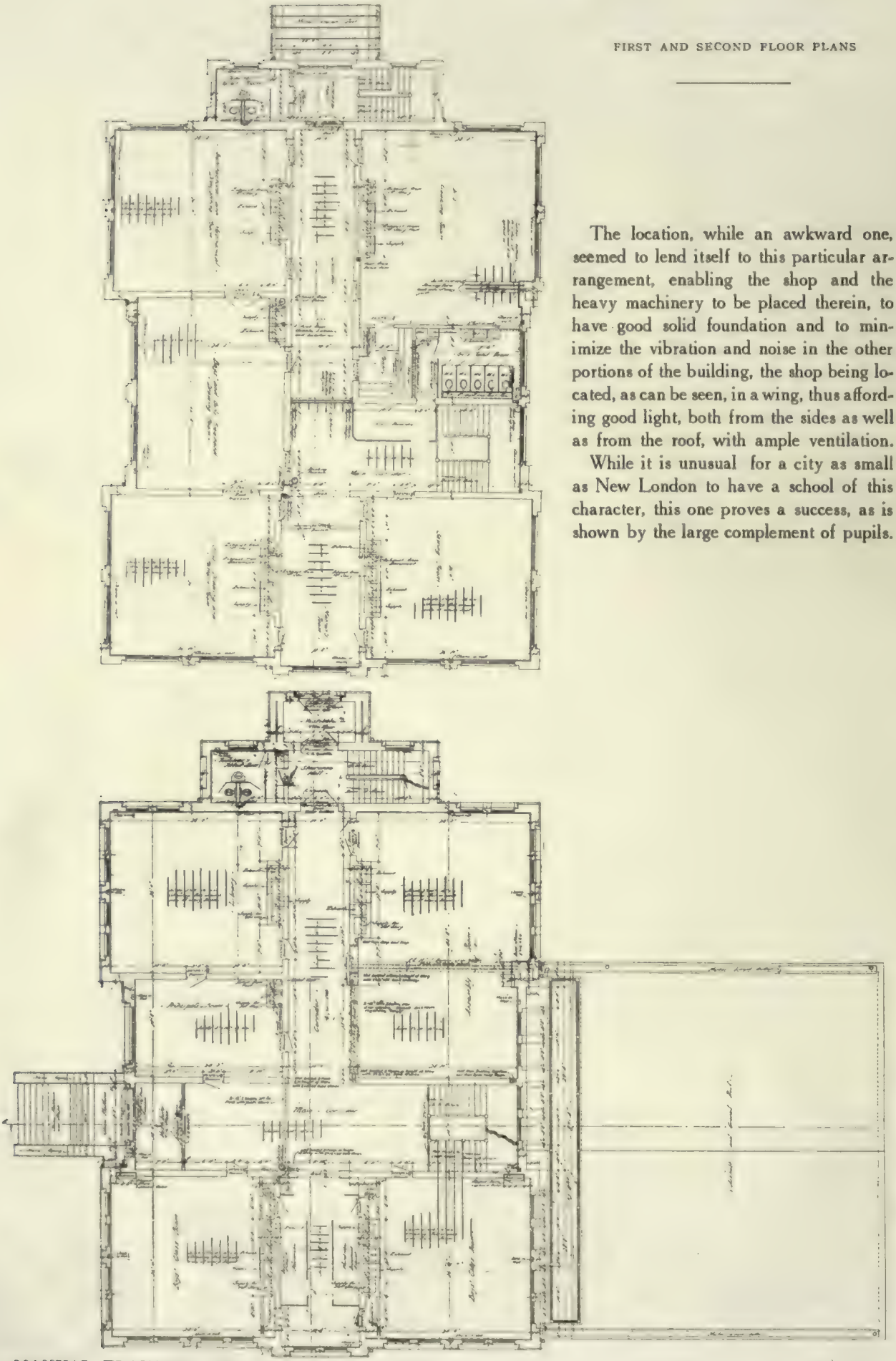
BASEMENT

PLAN

MANUAL TRAINING AND INDUSTRIAL SCHOOL
NEW LONDON, CONN.

MR. DUDLEY ST. C. DONNELLY
ARCHITECT

FIRST AND SECOND FLOOR PLANS

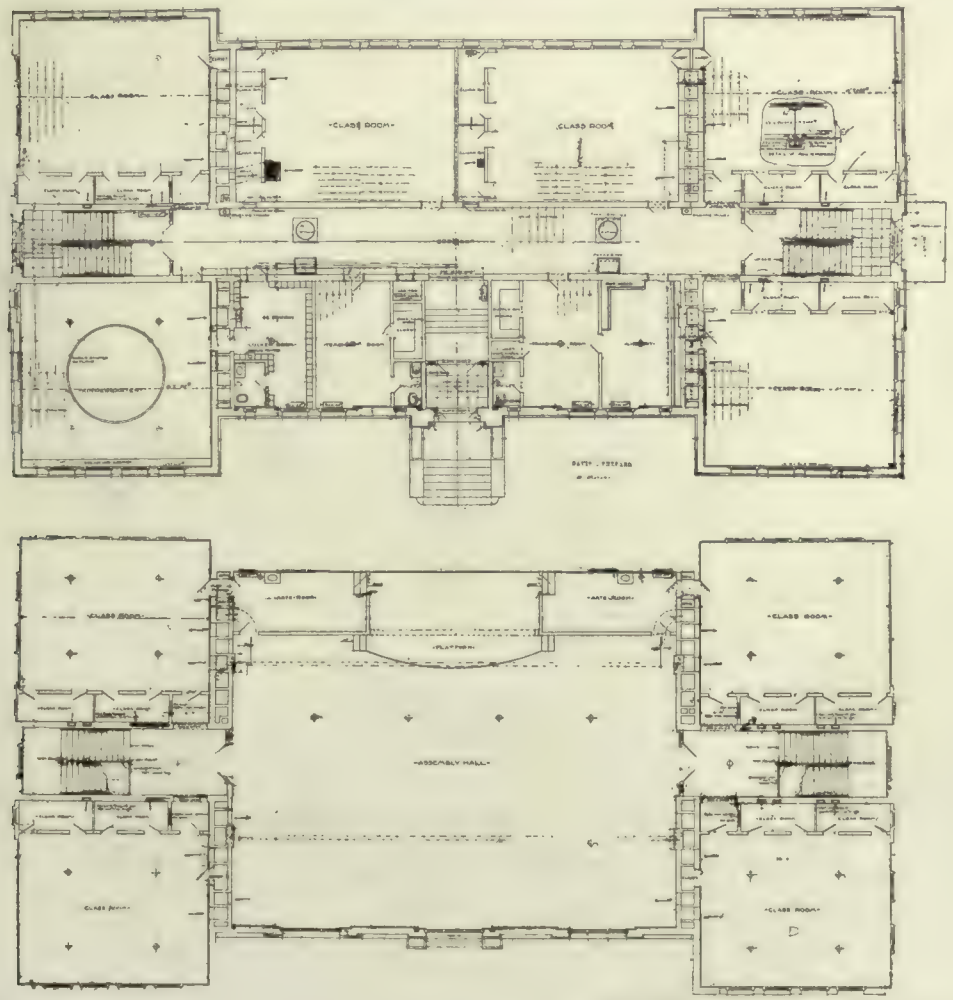


The location, while an awkward one, seemed to lend itself to this particular arrangement, enabling the shop and the heavy machinery to be placed therein, to have good solid foundation and to minimize the vibration and noise in the other portions of the building, the shop being located, as can be seen, in a wing, thus affording good light, both from the sides as well as from the roof, with ample ventilation.

While it is unusual for a city as small as New London to have a school of this character, this one proves a success, as is shown by the large complement of pupils.

MANUAL TRAINING AND INDUSTRIAL SCHOOL
NEW LONDON, CONN.

MR. DUDLEY ST. C. DONNELLY
ARCHITECT



LIBERTY SCHOOL
ENGLEWOOD, N. J.

MESSRS. DAVIS, McGRATH & KIESSLING
ARCHITECTS

This school building contains nine (9) class rooms 24' 0" x 30' 0", accommodating 40 scholars each and one kindergarten room, 29' 0" x 30' 0", and a large assembly hall on the second floor, seating capacity 450. The staircases are located at the ends of a long central hall and are constructed entirely of iron, except for the treads which are 2" oak plank.

The principal's room, teachers' room and school library are located on the first story, convenient to the central entrance.

The finished floors throughout are of maple; the walls are plastered on wood lath; the ceilings plastered on metal lath. All flashings and gutters are of heavy copper.

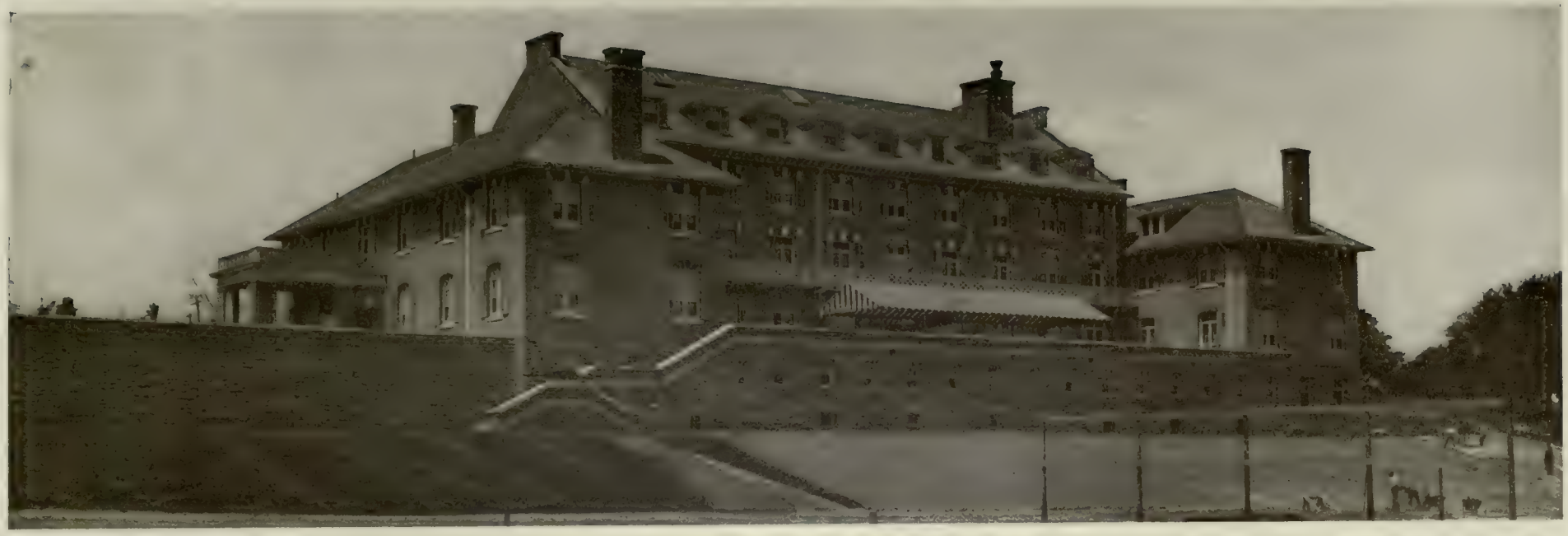
The exterior brickwork is laid up with local red brick, manufactured at Hackensack, N. J. The trimmings are of Indiana limestone.

The heating system was laid out for a gravity system, supplemented with four fans located in the cold air chambers at the base of each stack of flues, the fans to be used only when gravity would not supply sufficient air. At the foot of each stack is also located a large hot air furnace and in addition to this a large steam boiler supplies heat to the corridors and coatrooms, also for aspirating coils in the vent flues

The total cost of the building, including Architects' fees, was $40,000. Cost per cubic foot, 8 1-2 cents.

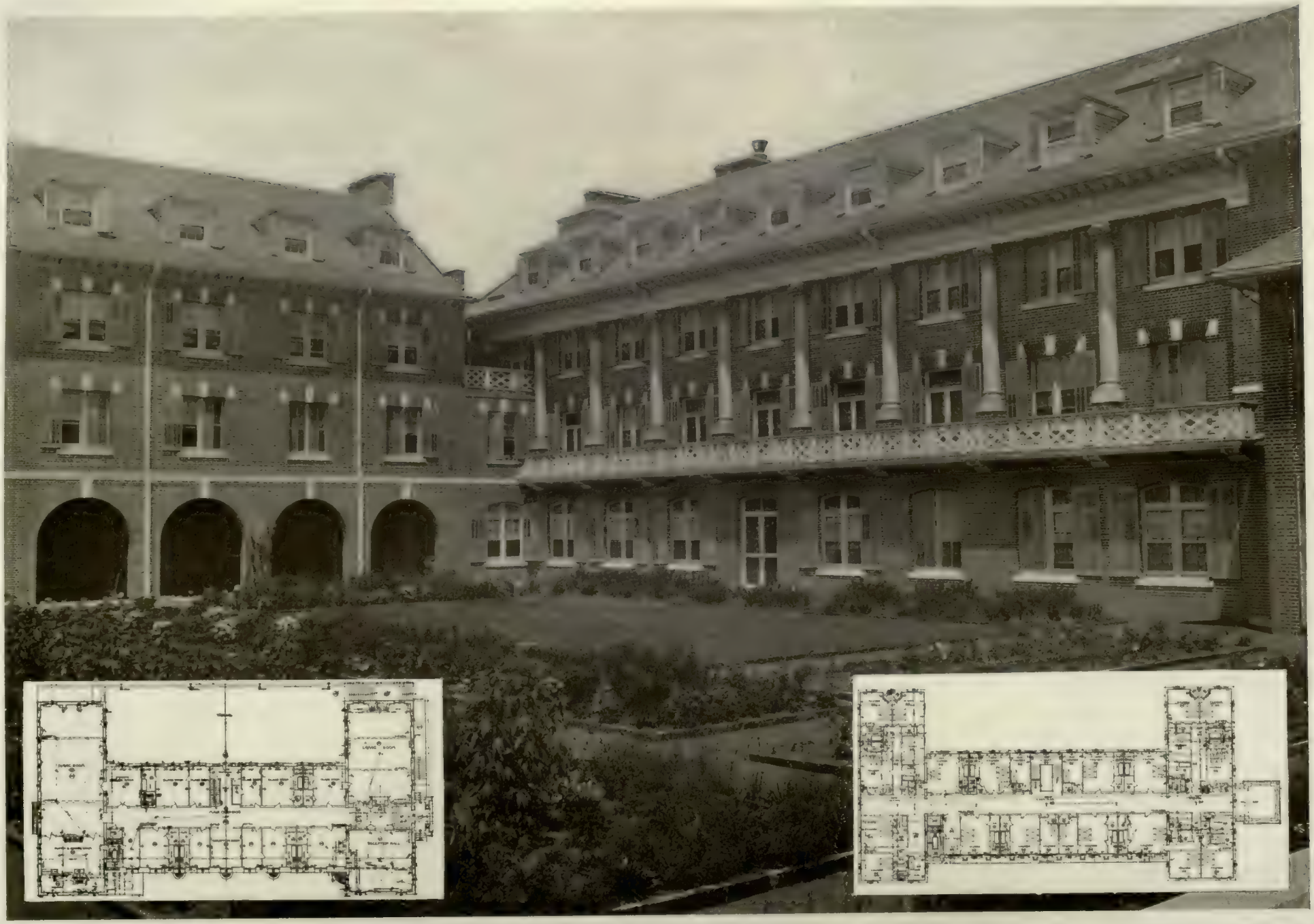
LIBERTY SCHOOL
ENGLEWOOD, N. J.

MESSRS. DAVIS, McGRATH & KIESSLING
ARCHITECTS



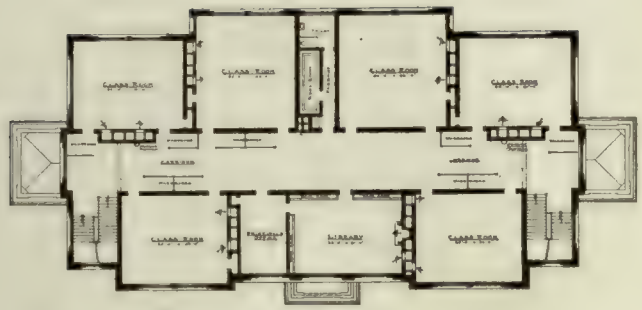
ELY SCHOOL FOR GIRLS,
GREENWICH, CONN.

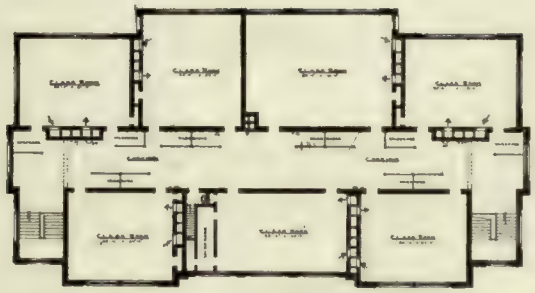
MESSRS. CARRERE & HASTINGS,
ARCHITECTS

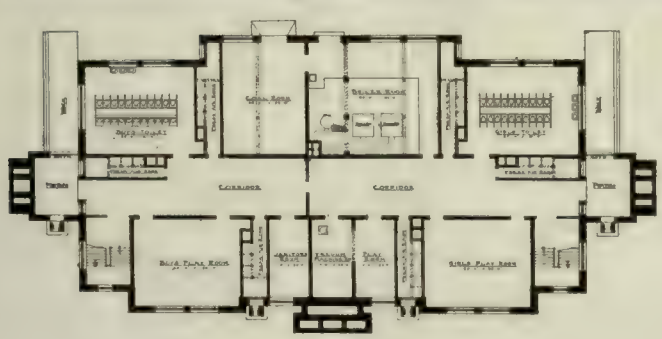


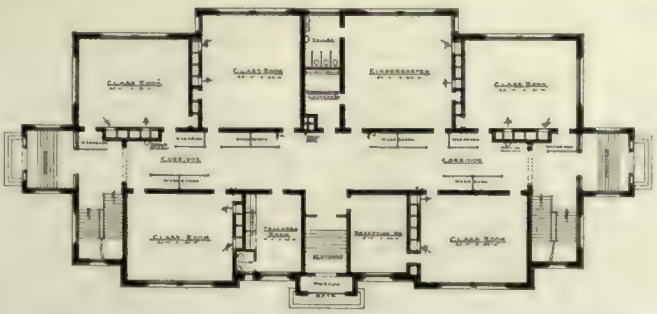
ELY SCHOOL FOR GIRLS,
GREENWICH, CONN.

MESSRS. CARRERE & HASTINGS,
ARCHITECTS



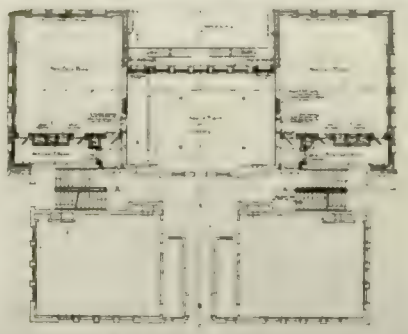






HARBOR SCHOOL,
NEW LONDON, CONN.

MR. JAMES SWEENEY,
ARCHITECT



This building contains ten classrooms on the first and second stories and a large assembly hall on the third; also a principal's room and teachers' room.

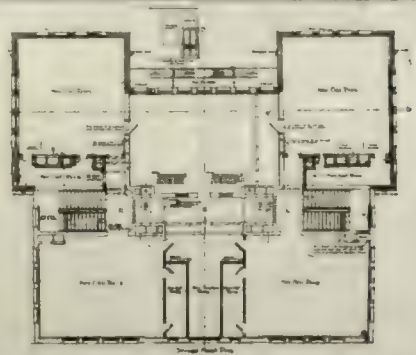
The staircases are constructed entirely of iron with slate treads and platforms.

The building is heated by two groups of hot-air furnaces and a small steam boiler. The furnaces are arranged in two banks with electrically driven fans forcing the cold air over the furnaces to the warm-air flues leading to each room. They are so designed that if the mechanical power is broken down for any reason the apparatus will work under gravity.

The finished floors throughout are of maple. The ceilings are plastered on metal lath; side walls on wood lath. The exterior brickwork is laid up with a local washed brick in red mortar with joints set in 1-4 inch. The basement story is laid up with a light gray local stone. The upper portion is trimmed with Indiana limestone.

The building, as originally erected, contained six classrooms, the second portion of four additional classrooms on the two rear corners and an assembly hall on the third story.

The total cost under these conditions, including architects' fees, was $48,000.00. The cubic contents of the building are 314,288, making a cubic foot cost 15 cents.

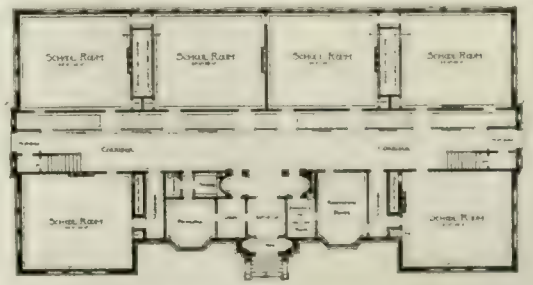


SCHOOL HOUSE AT LEONIA, N. J.

MESSRS. DAVIS, McGRATH & KIESSLING ARCHITECTS

BLISS SCHOOL
ATTLEBORO, MASS.

MESSRS. COOPER & BAILEY
ARCHITECTS

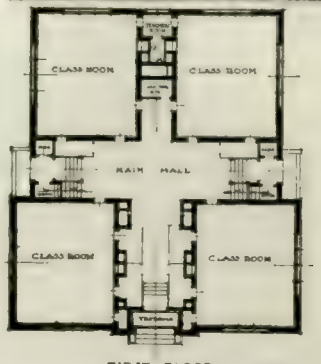


WINSLOW SCHOOL, BEVERLY, MASS.

MESSRS. COOPER & BAILEY, ARCHITECTS

This building is of common brick with a slate roof and heated by the gravity system. Its cost per cubic foot was 9 1-2 cents.

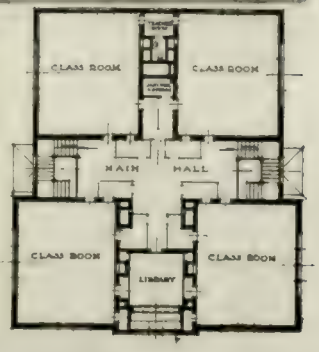
MODEL SCHOOL BUILDING AT STATE NORMAL SCHOOL, NEW BRITAIN, CONN. MESSRS. DAVIS & BROOKS, ARCHITECTS



FIRST FLOOR

This school was so arranged that four rooms were built at one time, and four rooms at a later date. The building is of common brick with a tin roof and is heated by the gravity system. The first building was erected in 1898 at a cost of 8 3-4 cents per cubic foot. The four additional rooms were built in 1907 and cost 11.4 cents per cubic foot.

MONROE STREET SCHOOL, NEW BRITAIN, CONN. MESSRS. DAVIS & BROOKS, ARCHITECTS

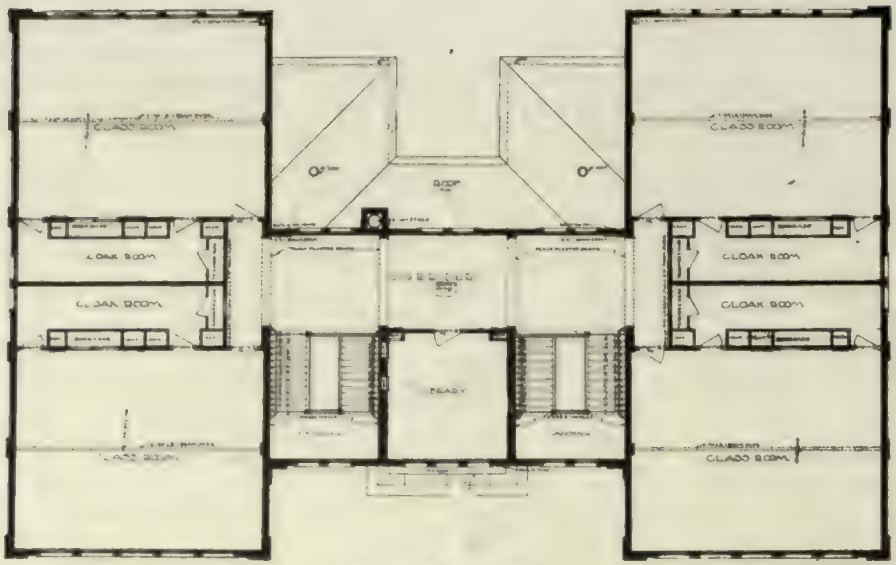


SECOND FLOOR

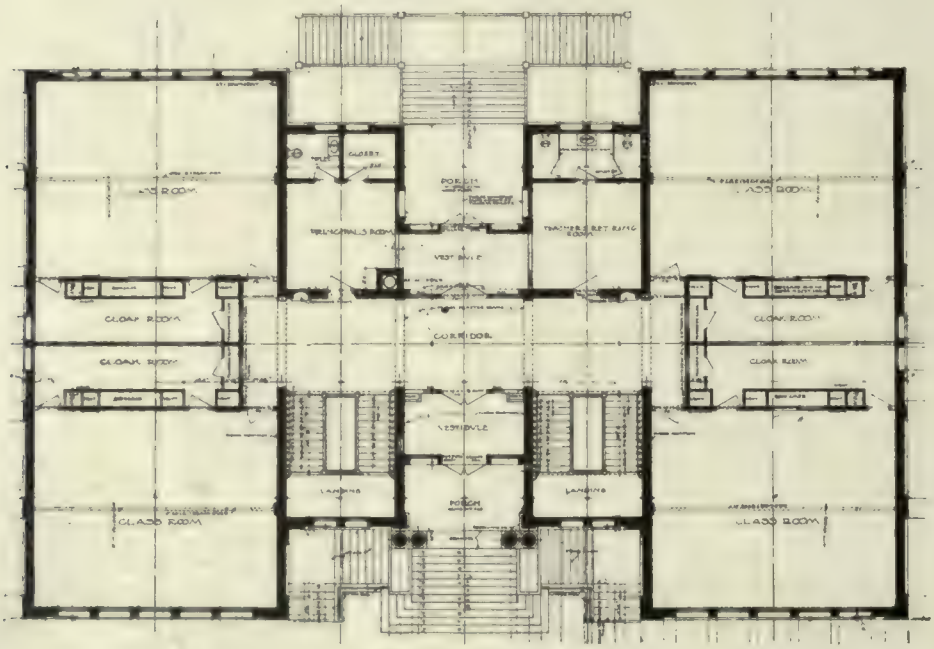
EIGHTH WARD SCHOOL
ATLANTA, GA.

This was the first of the modern schools to be erected at Atlanta. It is constructed of light-brown brick with limestone trimmings. It has metal cornices and light-brown terra-cotta entrances. There is no auditorium in this schoolhouse.

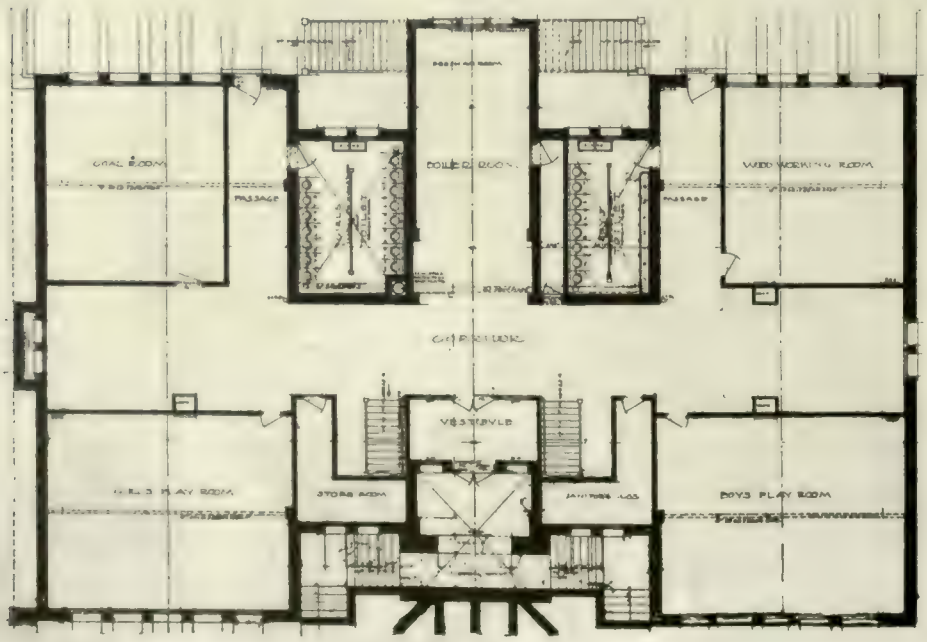
MR. HARALSON BLECKLEY
ARCHITECT



SECOND FLOOR PLAN



FIRST FLOOR PLAN



BASEMENT PLAN

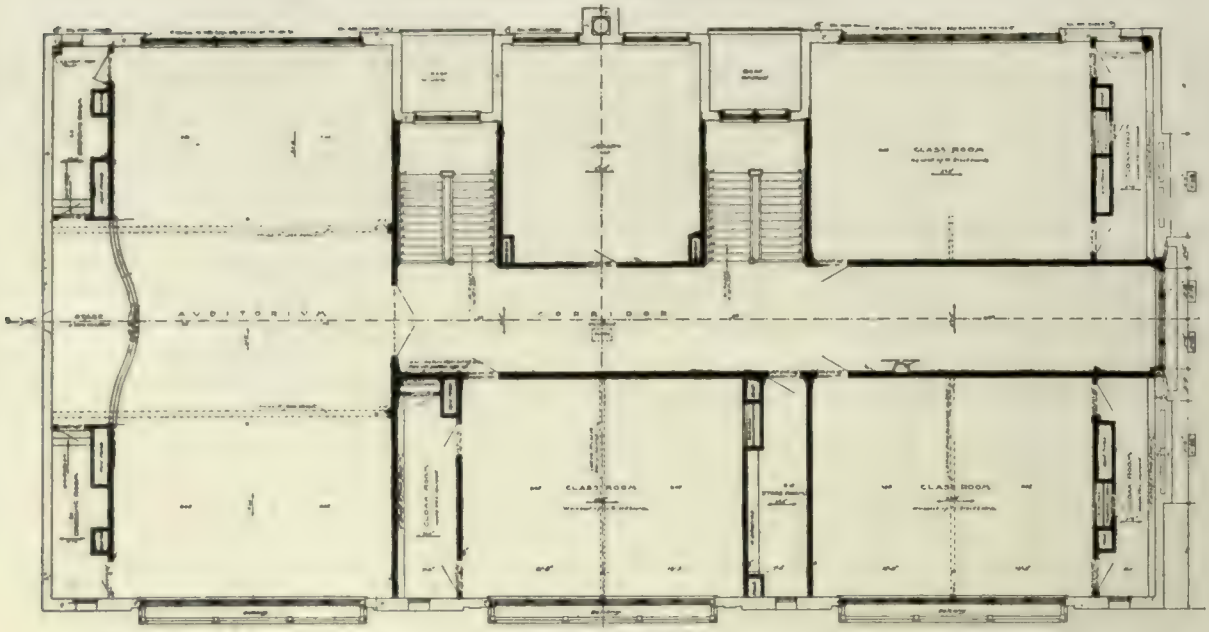
EIGHTH WARD
GRAMMAR SCHOOL
ATLANTA, GA.

MR. HARALSON BLECKLEY
ARCHITECT

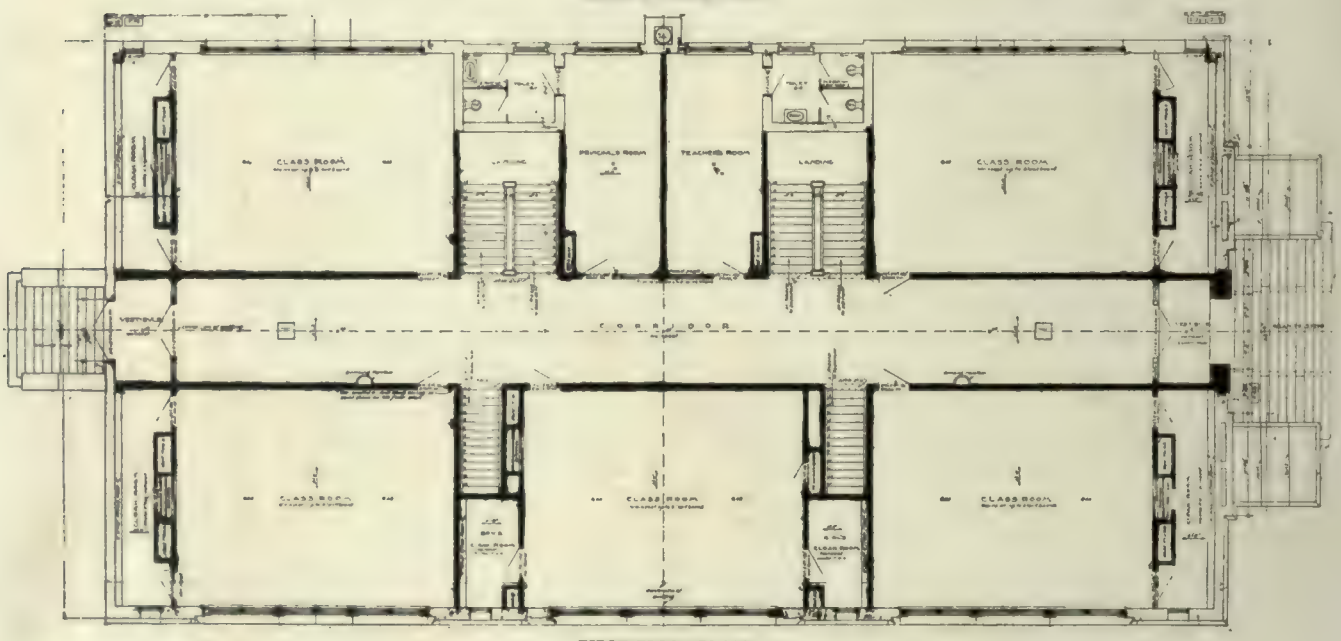
FOURTH WARD SCHOOL
ATLANTA, GA.

This school is constructed of cherry-red brick, with a limestone base and entrances. The auditorium is located on the second floor, and the boys' and girls' gymnasium in the basement.

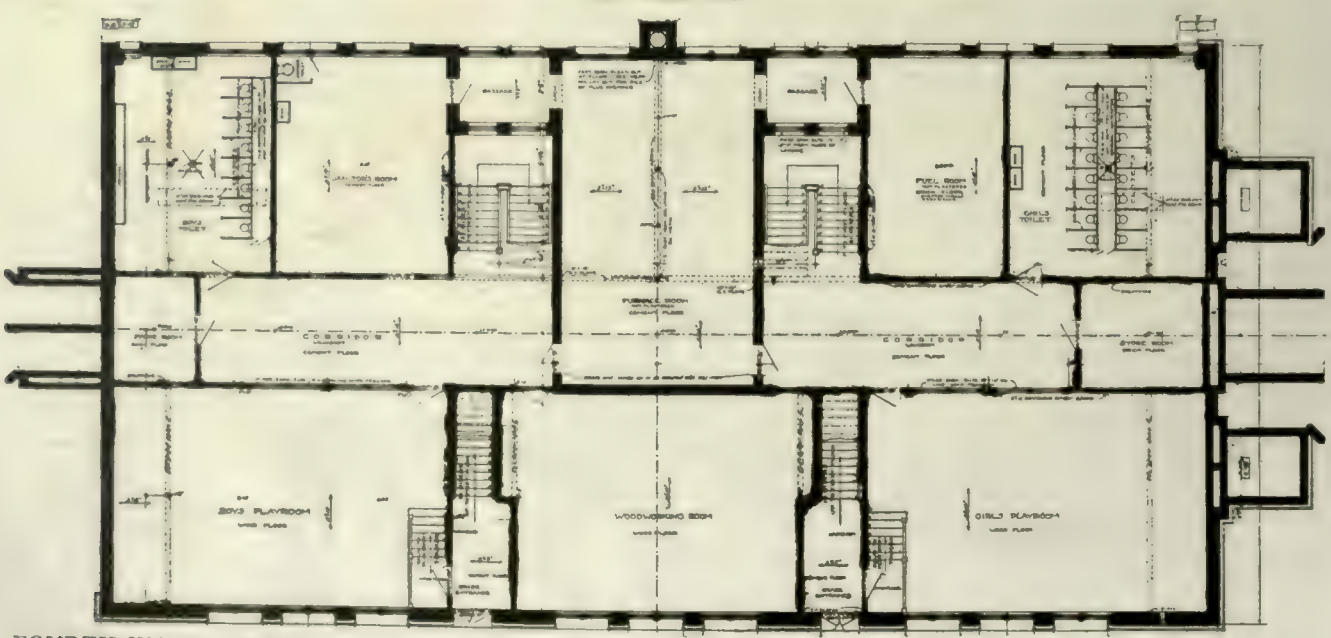
MR. HARALSON BLECKLEY
ARCHITECT



SECOND FLOOR PLAN



FIRST FLOOR PLAN



FOURTH WARD SCHOOL
ATLANTA, GA.

BASEMENT PLAN

MR. HARALSON BLECKLEY
ARCHITECT

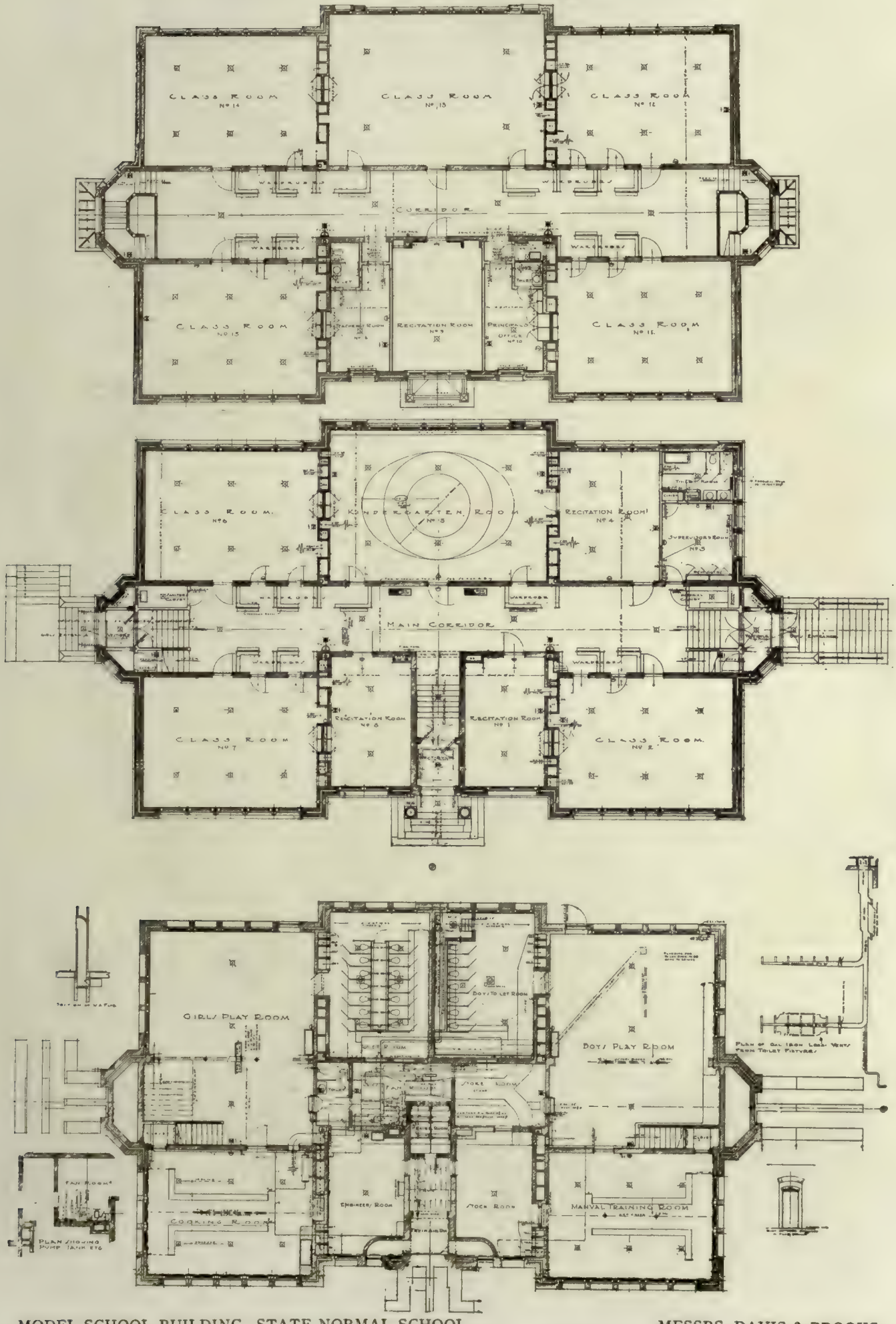
This school was built of common brick with limestone trim above and granite in basement. The walls of both rooms and corridors are of painted brick and the whole building designed with every economy. Cost, including heating and plumbing, and with exception of boilers, which are in a separate building, 13 1-5 cents per cubic foot.

MODEL SCHOOL BUILDING—STATE NORMAL SCHOOL
WILLIMANTIC, CONN.

MESSRS. DAVIS & BROOKS
ARCHITECTS

MODEL SCHOOL BUILDING—STATE NORMAL SCHOOL
WILLIMANTIC, CONN.

MESSRS. DAVIS & BROOKS
ARCHITECTS

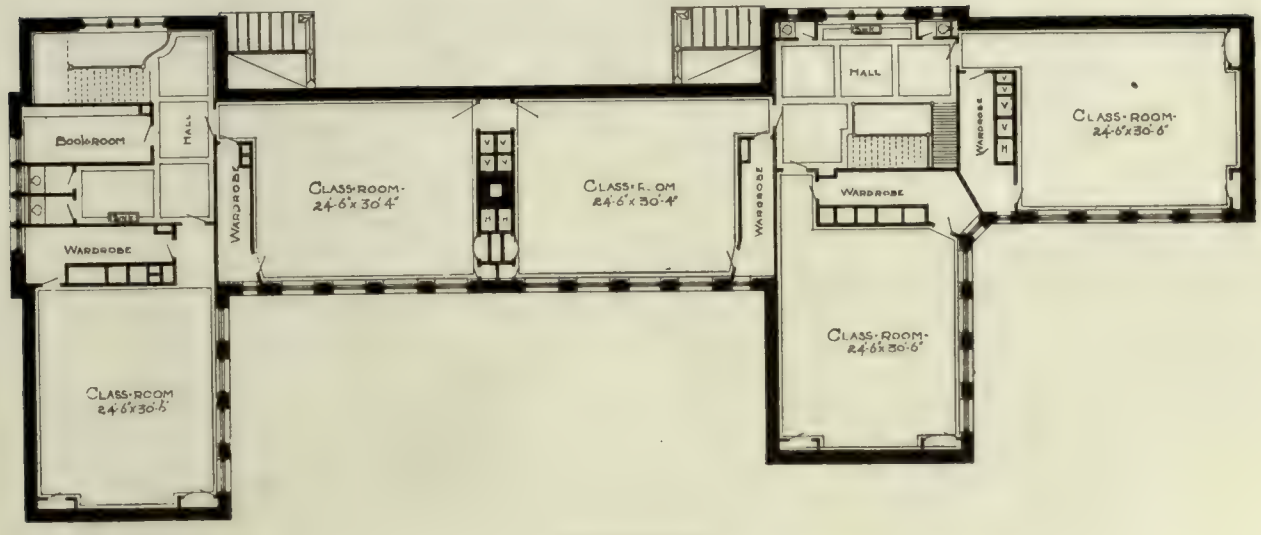


MODEL SCHOOL BUILDING—STATE NORMAL SCHOOL
WILLIMANTIC, CONN.

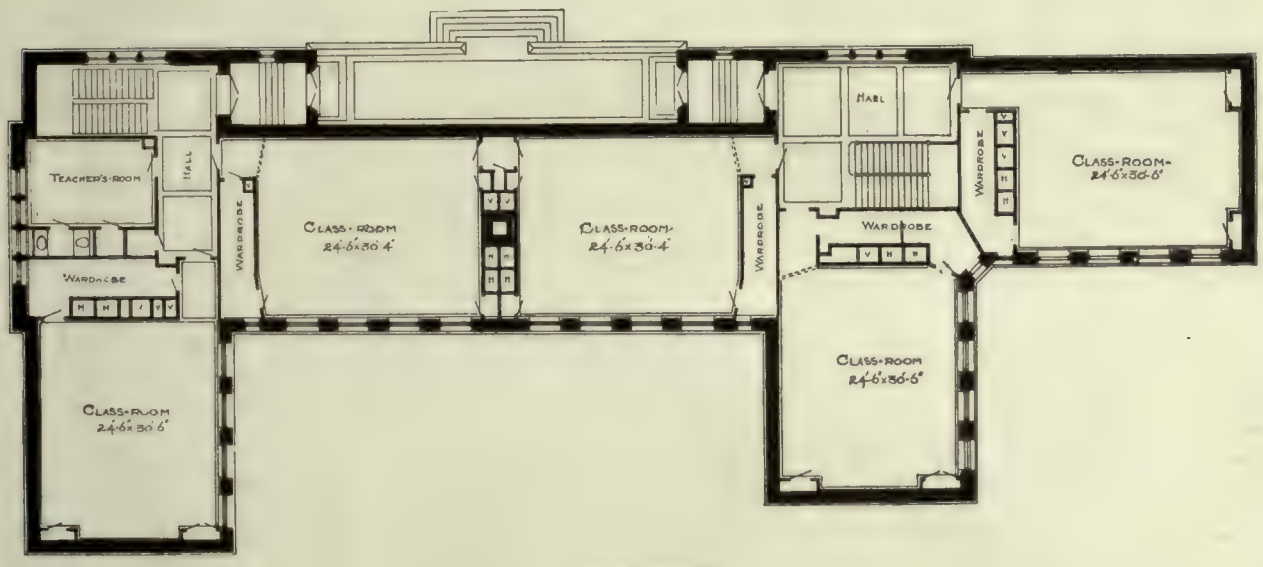
MESSRS. DAVIS & BROOKS
ARCHITECTS

TUCKERMAN PRIMARY SCHOOL
SOUTH BOSTON, MASS.

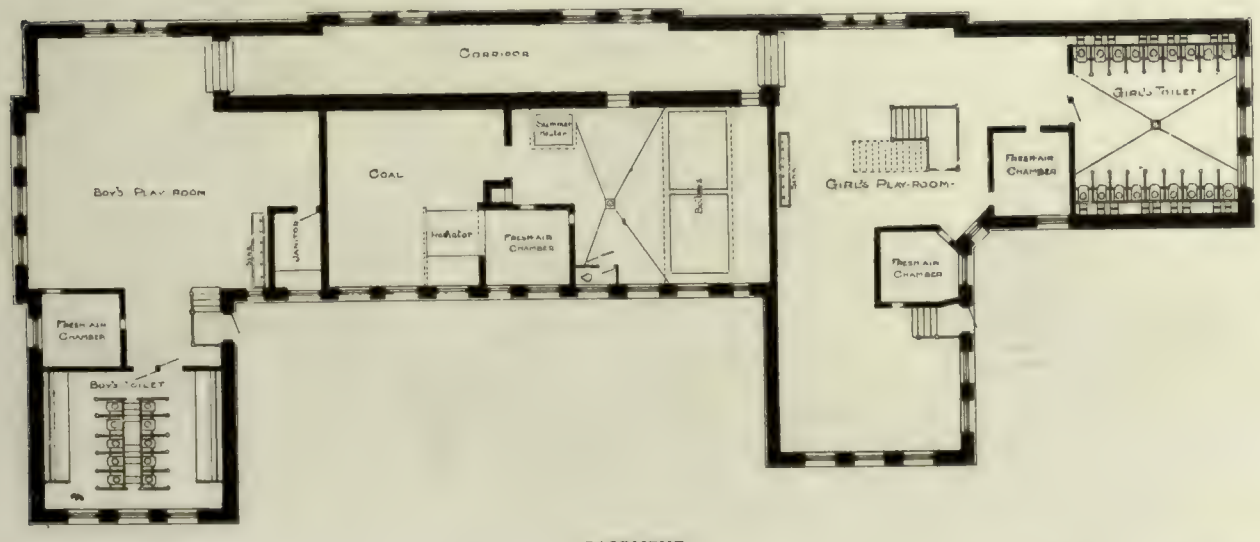
CHARLES K. CUMMINGS
ARCHITECT



SECOND FLOOR



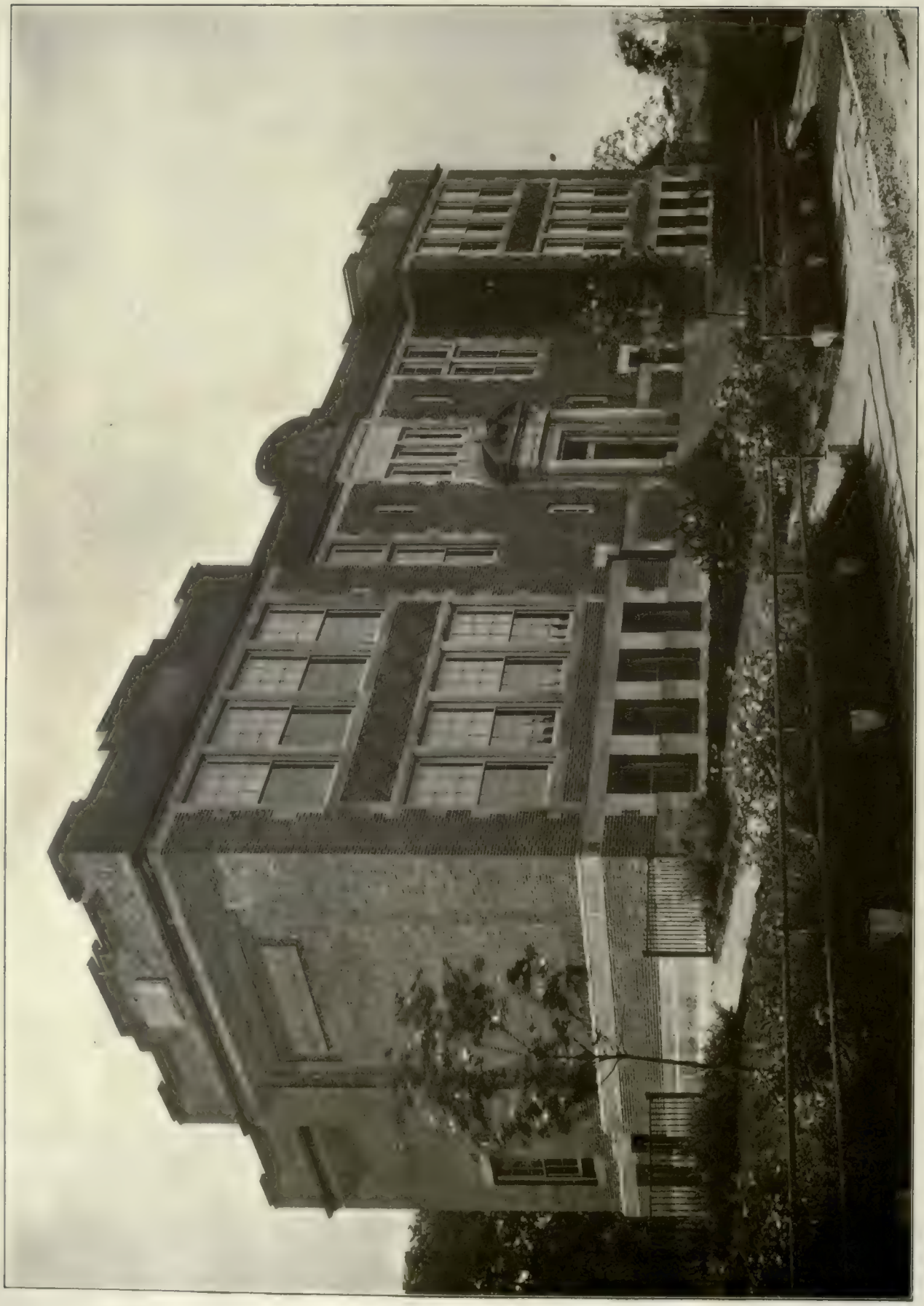
FIRST FLOOR



BASEMENT

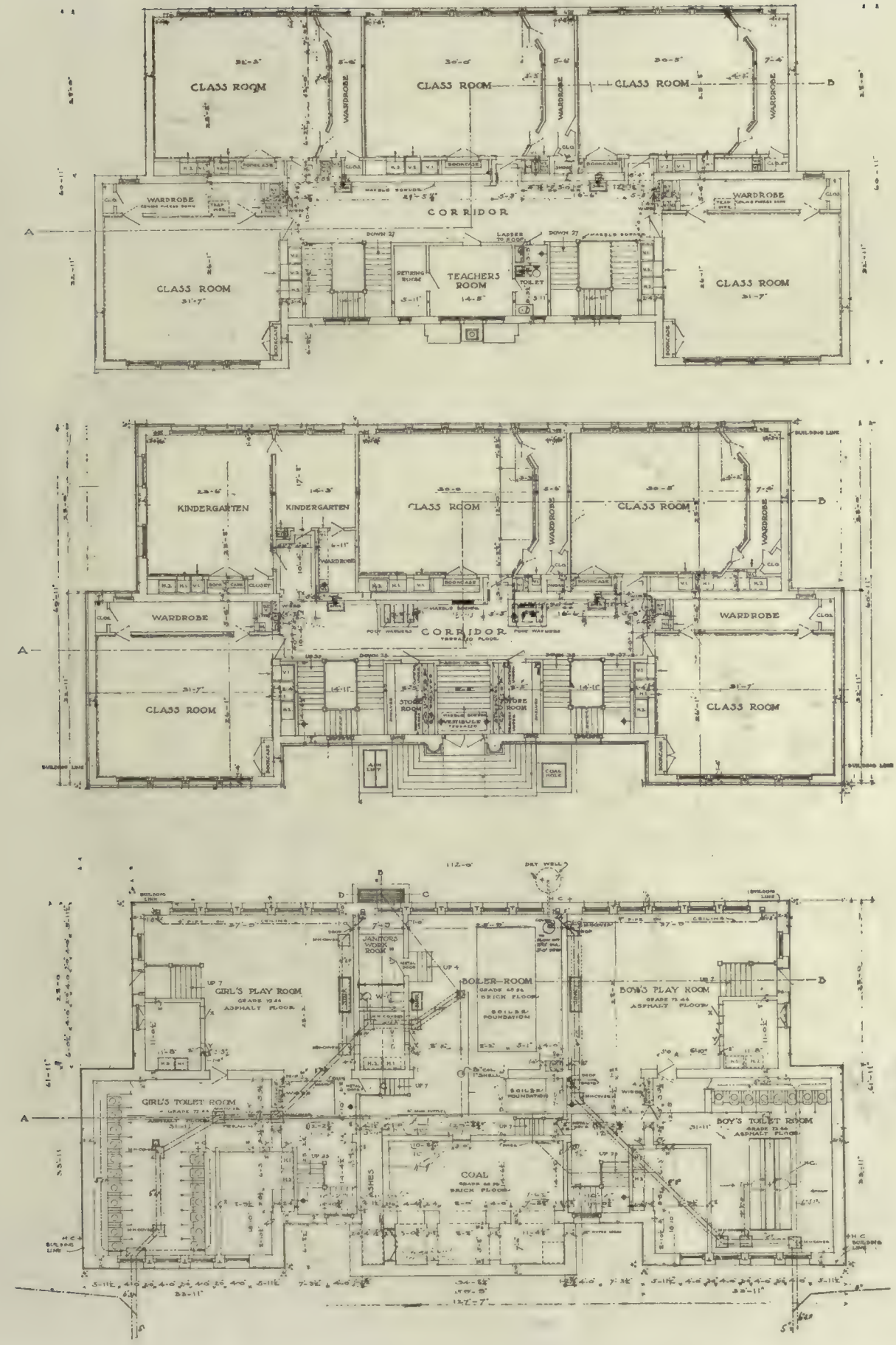
TUCKERMAN SCHOOL
SOUTH BOSTON, MASS.

CHARLES K. CUMMINGS
ARCHITECT



JOHN GREENLEAF WHITTIER SCHOOL
DORCHESTER, MASS.

PARKER & THOMAS
ARCHITECTS



JOHN GREENLEAF WHITTIER SCHOOL
DORCHESTER, MASS.

PARKER & THOMAS
ARCHITECTS

JOHN GREENLEAF WHITTIER SCHOOL
DORCHESTER, MASS.

PARKER & THOMAS
ARCHITECTS

BOYS' ENTRANCE, CHRISTOPHER GIBSON SCHOOL
DORCHESTER, MASS.

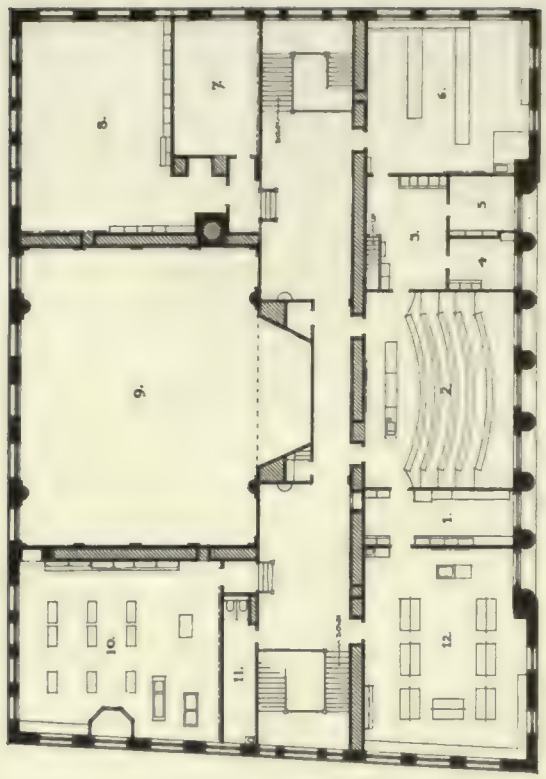
SHOWING RELATION OF MATHER SCHOOL TO THE MEETING HOUSE
DORCHESTER, MASS.

CHRISTOPHER GIBSON SCHOOL
DORCHESTER, MASS.

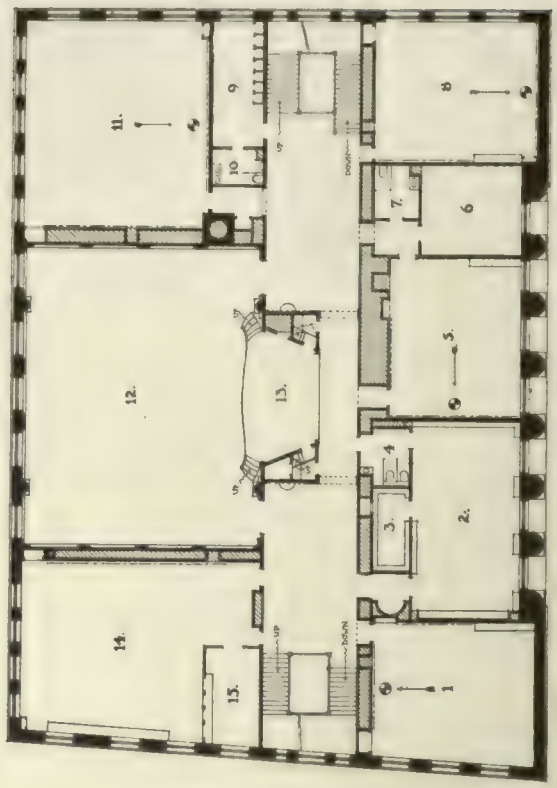
E. M. WHEELWRIGHT
ARCHITECT

STICKNEY & AUSTIN
ARCHITECTS

CHARLESTOWN HIGH SCHOOL
CHARLESTOWN, MASS.

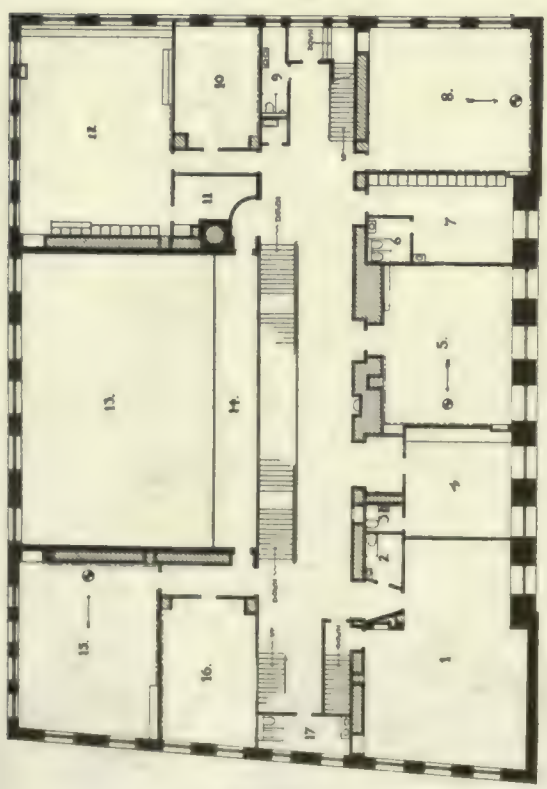


THIRD FLOOR PLAN.

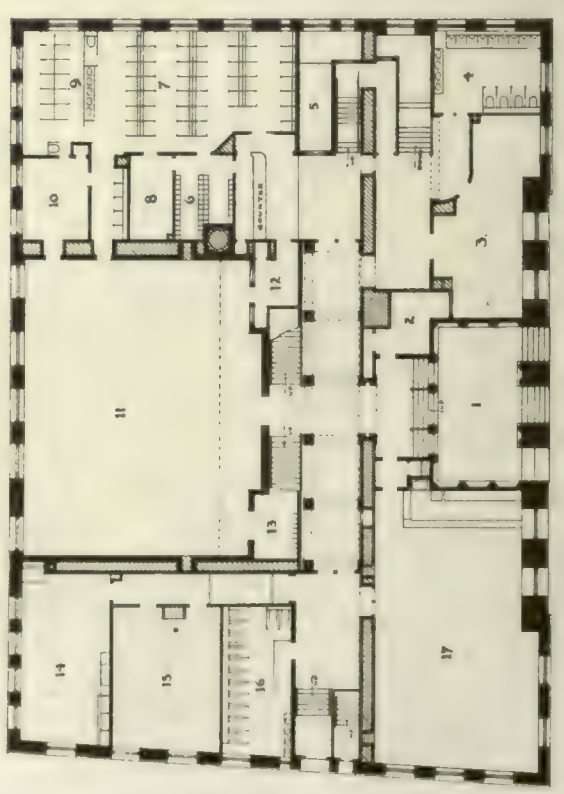


SECOND FLOOR PLAN.

STICKNEY & AUSTIN
ARCHITECTS



FIRST FLOOR PLAN.



GROUND FLOOR PLAN.

CHARLESTOWN HIGH SCHOOL, BUNKER HILL SQUARE
CHARLESTOWN, MASS.

MATHER GRAMMAR SCHOOL
DORCHESTER, MASS.

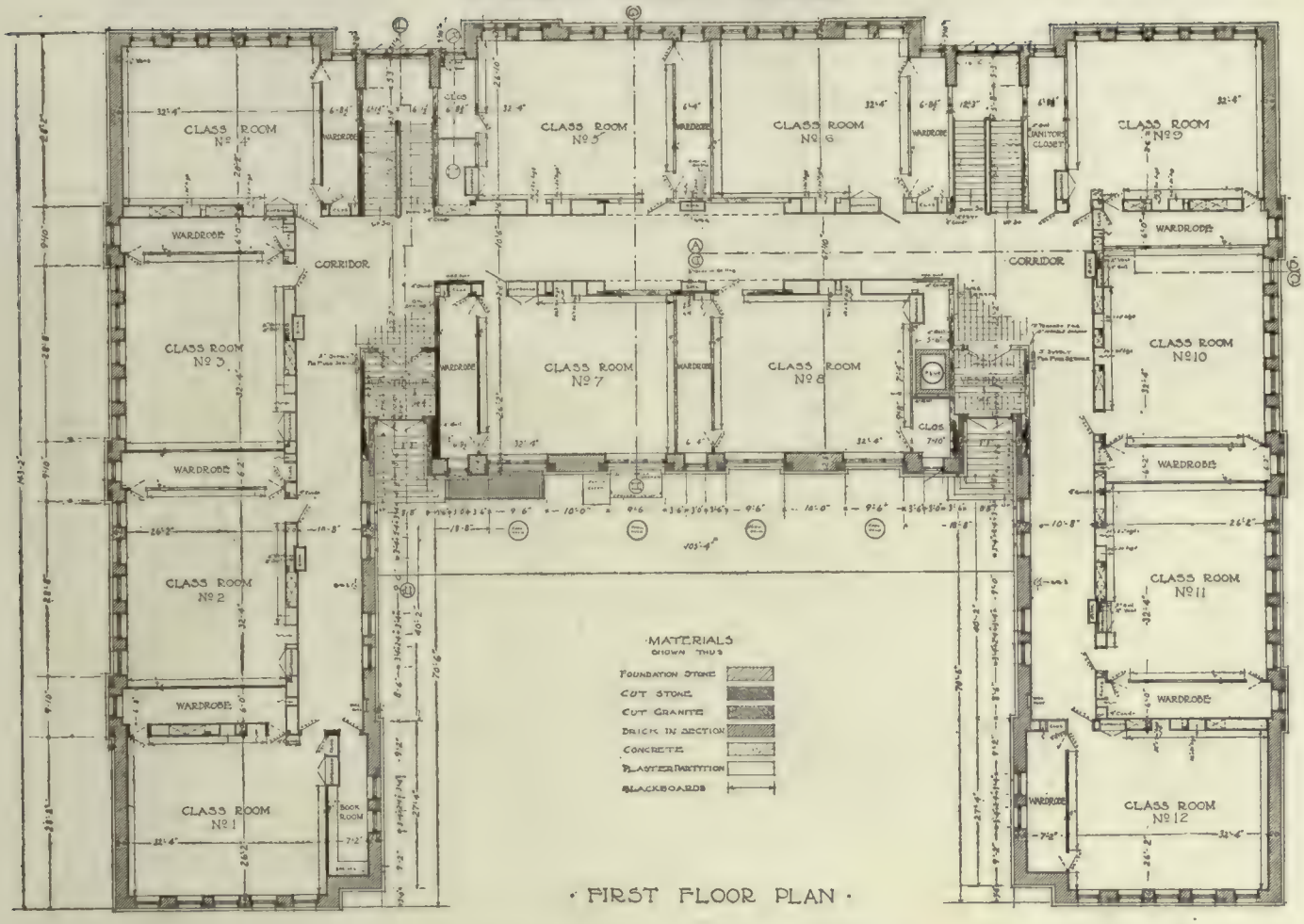
BOYS' ENTRANCE, ON THE MAIN COURT

CRAM, GOODHUE & FERGUSON
ARCHITECTS

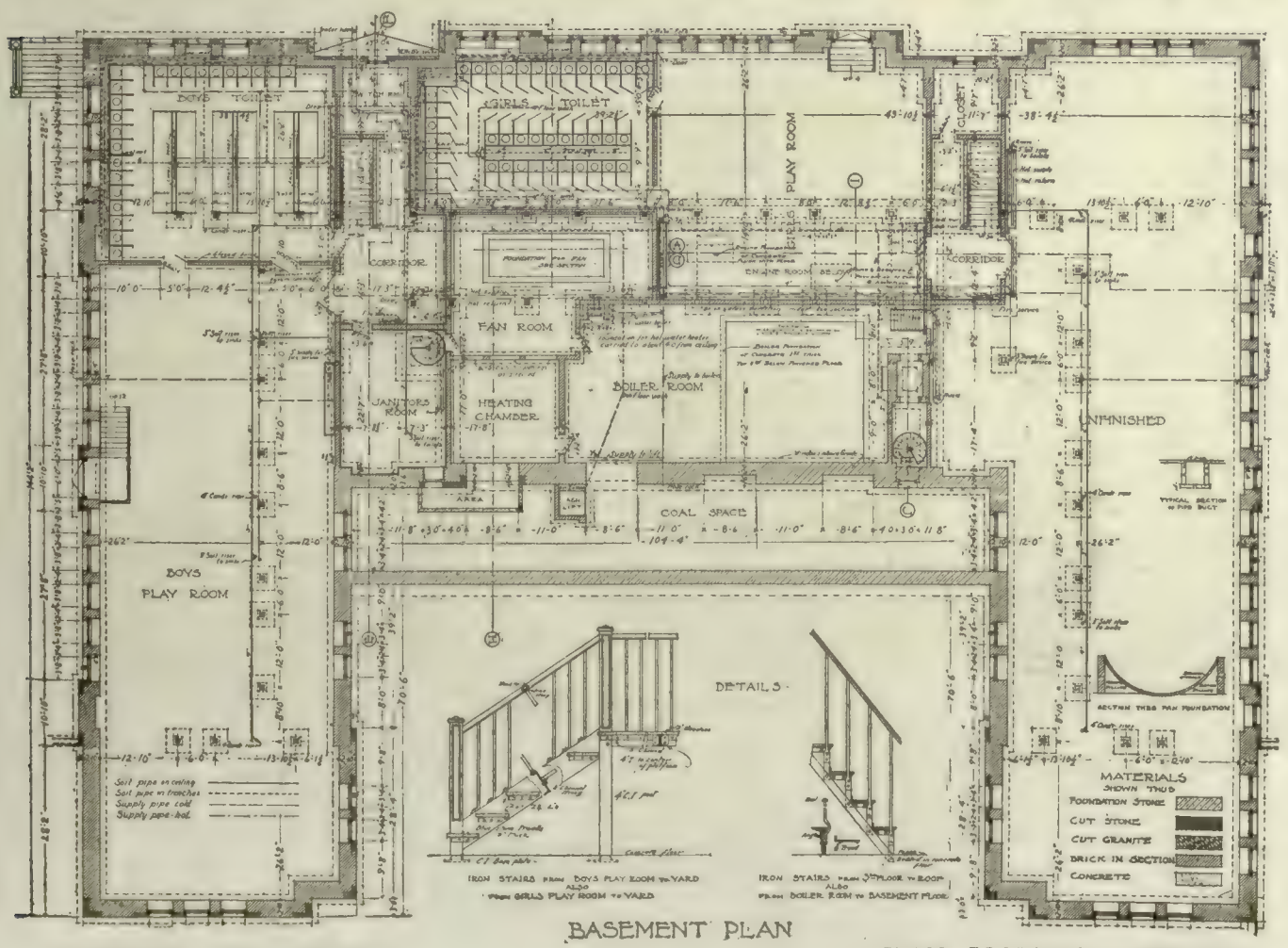
REAR VIEW (NORTH)

MATHER GRAMMAR SCHOOL
DORCHESTER, MASS.

CRAM, GOODHUE & FERGUSON
ARCHITECTS



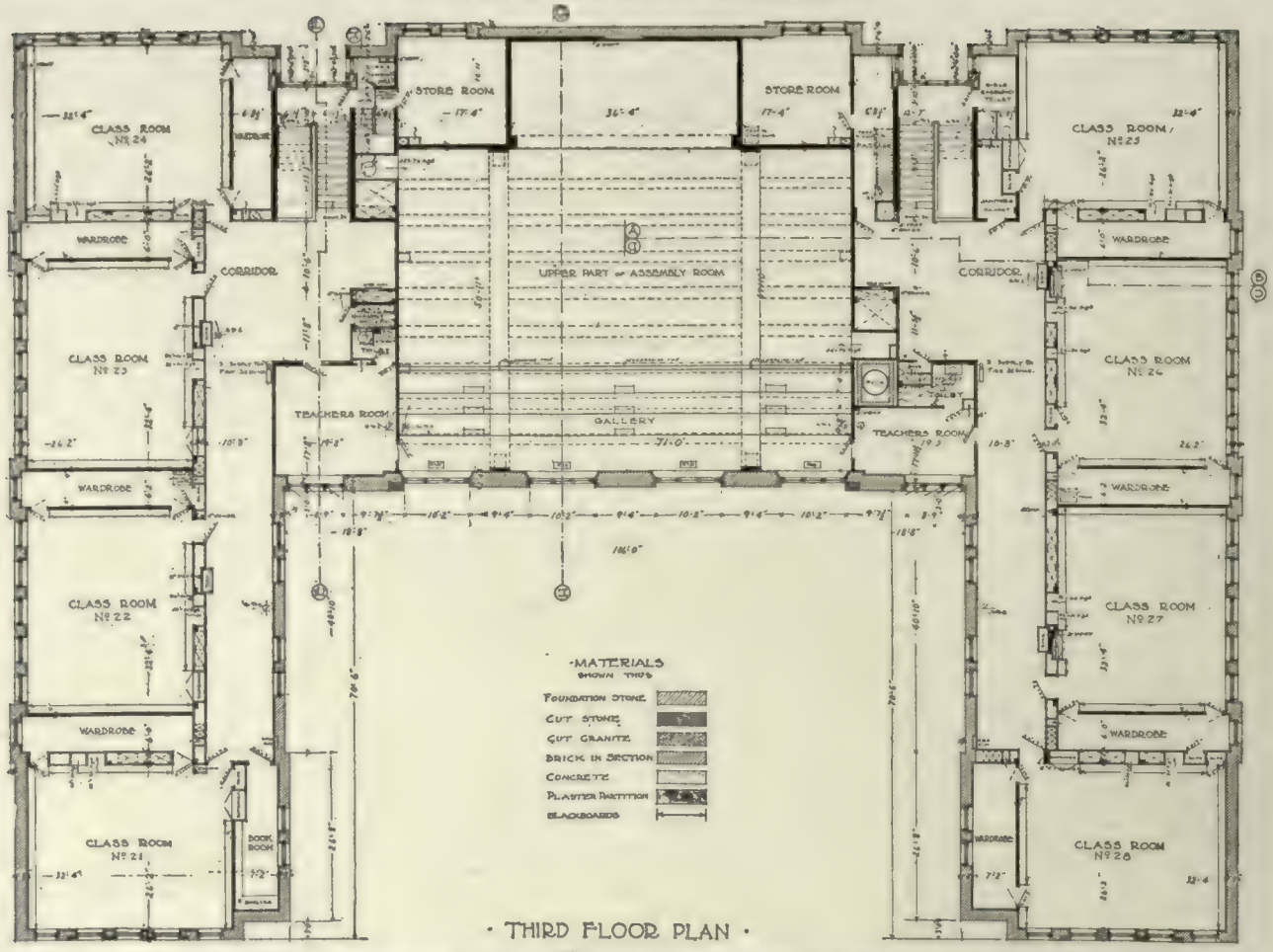
· FIRST FLOOR PLAN ·



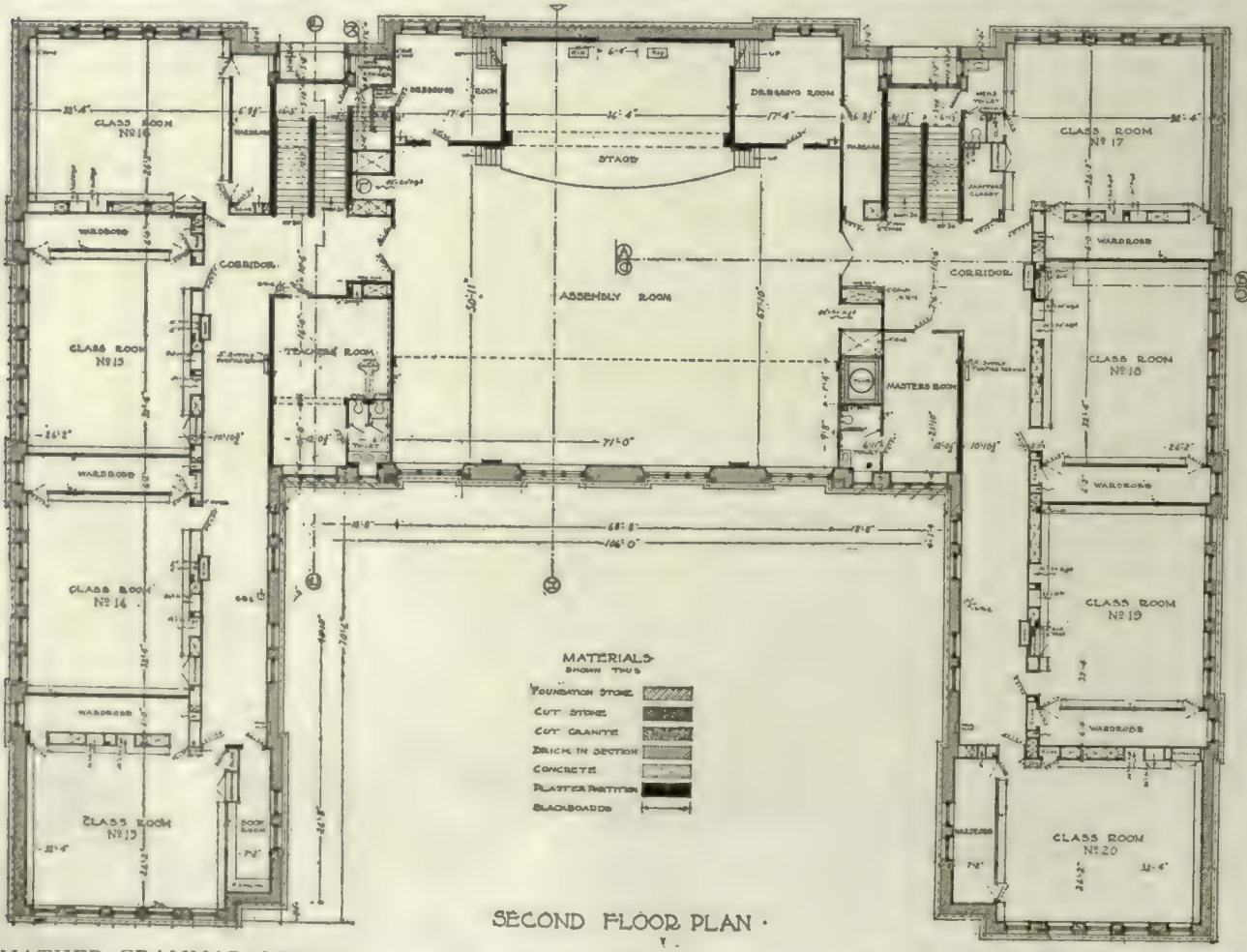
BASEMENT PLAN

MATHER GRAMMAR SCHOOL
DORCHESTER, MASS.

CRAM, GOODHUE & FERGUSON
ARCHITECTS



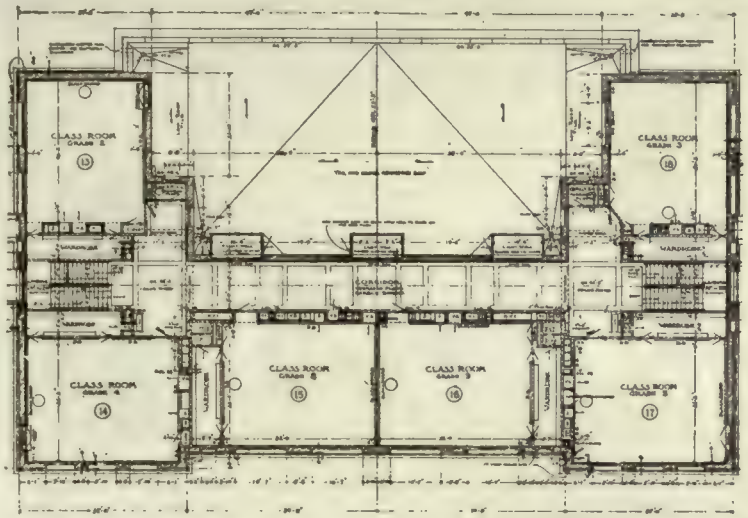
· THIRD FLOOR PLAN ·



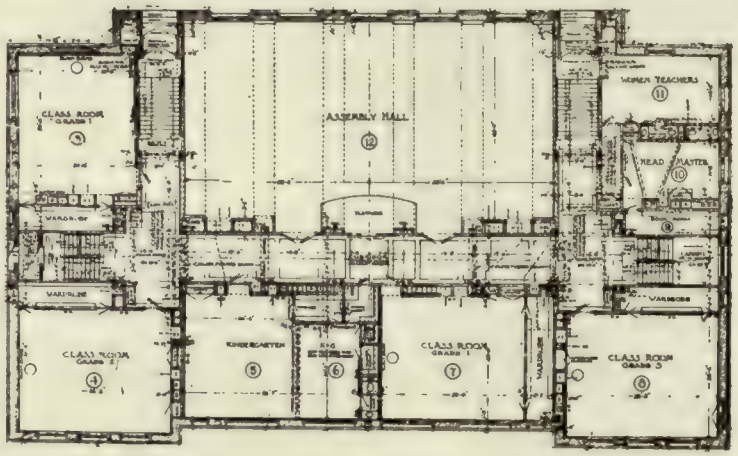
· SECOND FLOOR PLAN ·

MATHER GRAMMAR SCHOOL
DORCHESTER, MASS.

CRAM, GOODHUE & FERGUSON
ARCHITECTS

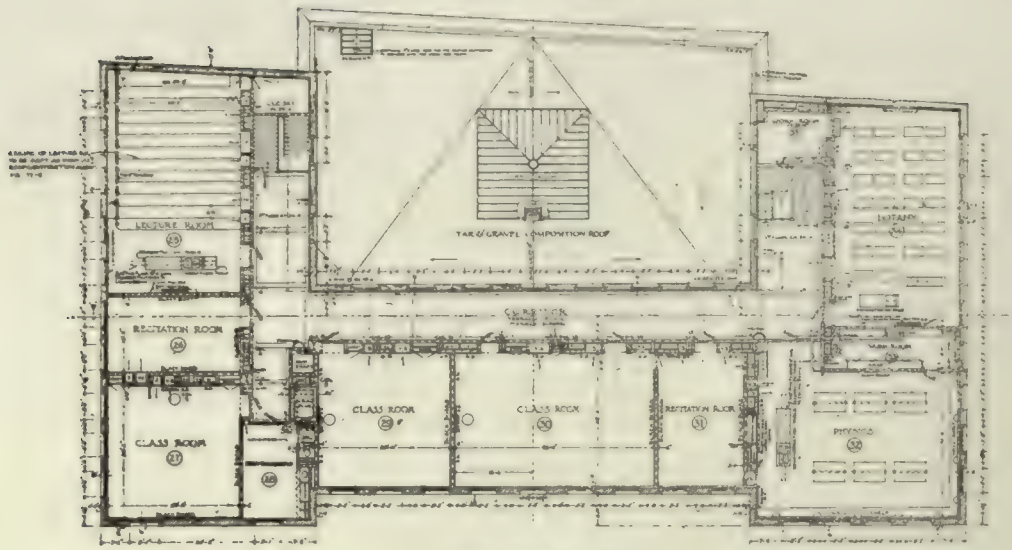


NORMAL AND LATIN SCHOOL GROUP
BOSTON, MASS.

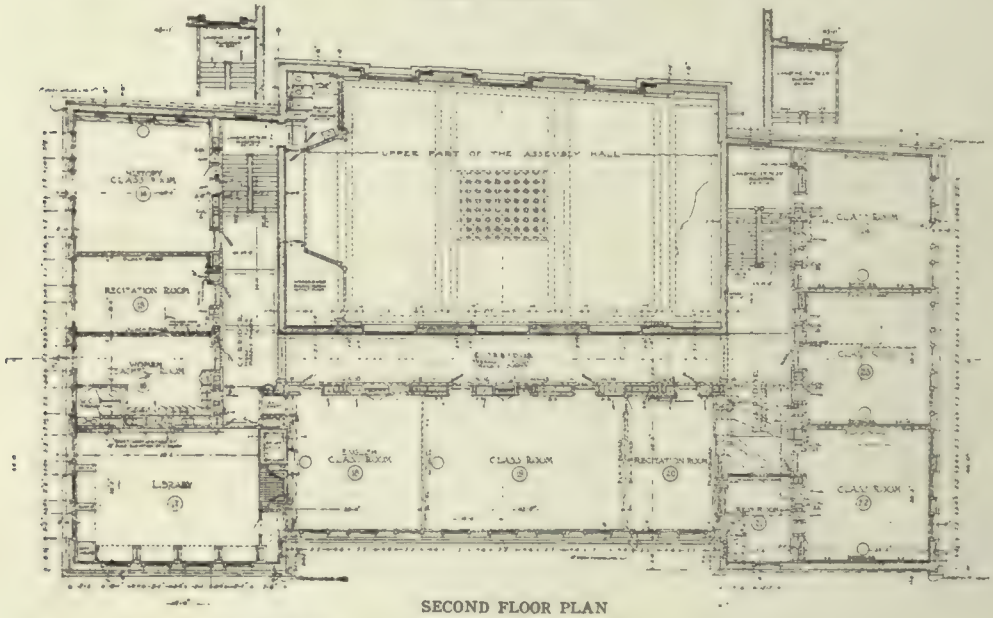


THE PATRICK COLLINS MODEL SCHOOL

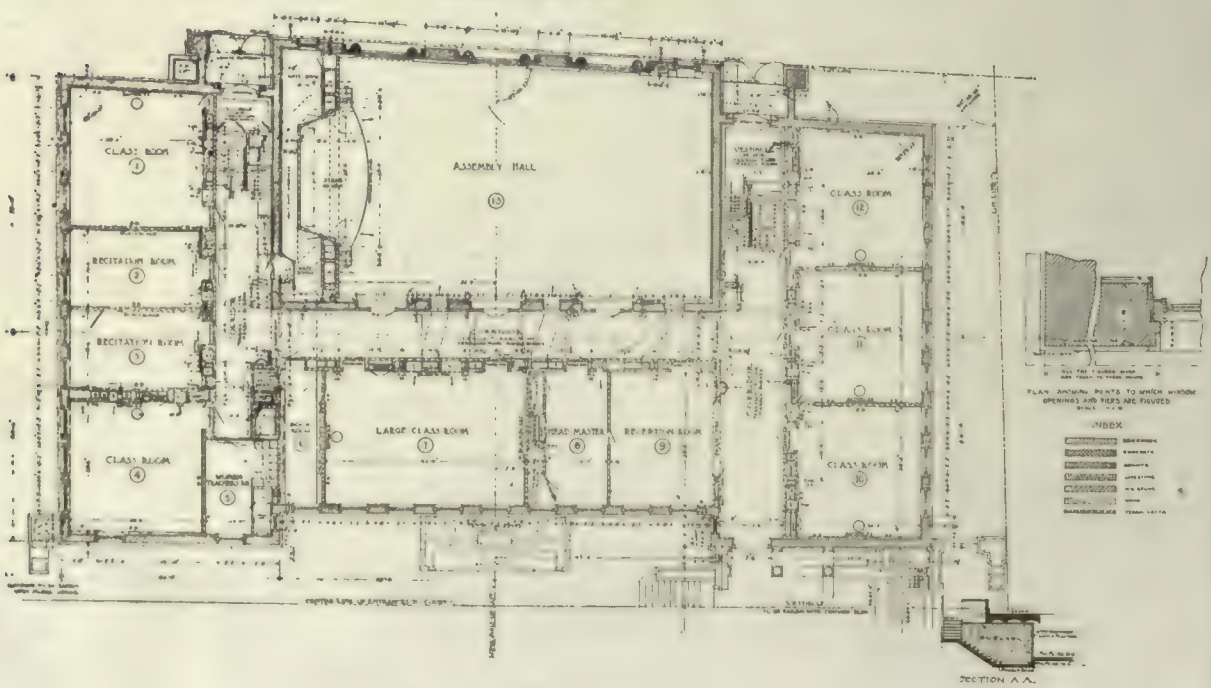
MESSRS. PEABODY & STEARNS, COOLIDGE & CARLSON AND
MAGINNIS, WALSH & SULLIVAN, ASSOCIATED ARCHITECTS



THIRD FLOOR PLAN



SECOND FLOOR PLAN



FIRST FLOOR PLAN

FLOOR PLANS, LATIN SCHOOL

NORMAL AND LATIN SCHOOL GROUP
BOSTON, MASS.

MESSRS. PEABODY & STEARNS, COOLIDGE & CARLSON AND MAGINNIS, WALSH & SULLIVAN, ASSOCIATED ARCHITECTS

SOUTHEAST ENTRANCE TO NORMAL SCHOOL AND COMMON BUILDING

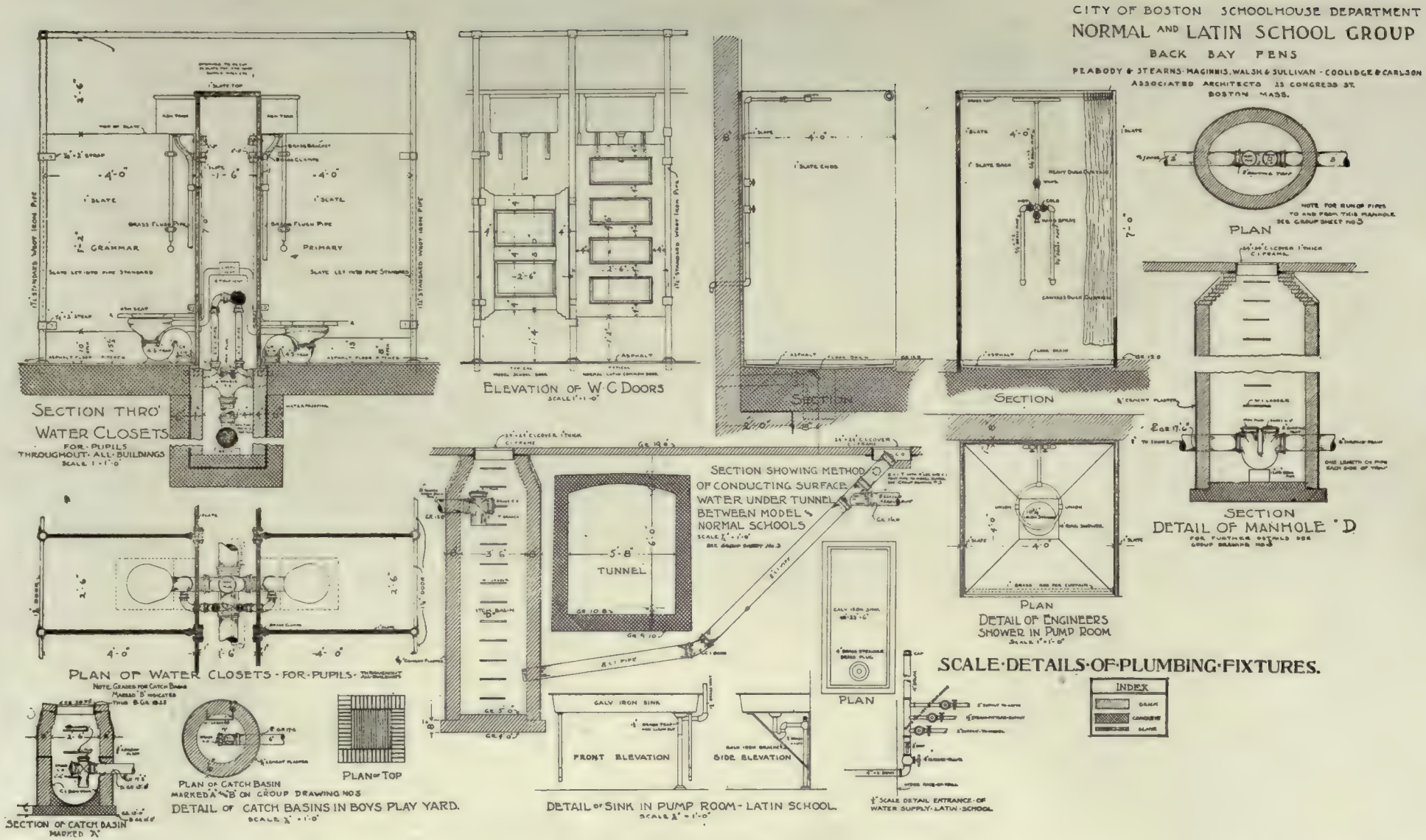
NORMAL AND LATIN SCHOOL GROUP
BOSTON, MASS.

MESSRS. PEABODY & STEARNS, COOLIDGE & CARLSON AND MAGINNIS, WALSH & SULLIVAN, ASSOCIATED ARCHITECTS

DETAIL OF COURTYARD, FRONT OF COMMON BUILDING

NORMAL AND LATIN SCHOOL GROUP
BOSTON, MASS.

MESSRS. PEABODY & STEARNS, COOLIDGE & CARLSON AND MAGINNIS, WALSH & SULLIVAN, ASSOCIATED ARCHITECTS


CITY OF BOSTON SCHOOLHOUSE DEPARTMENT
NORMAL AND LATIN SCHOOL GROUP
BACK BAY FENS
PEABODY & STEARNS · MAGINNIS, WALSH & SULLIVAN - COOLIDGE & CARLSON
ASSOCIATED ARCHITECTS 53 CONGRESS ST.
BOSTON MASS.
SECTION THRO' WATER CLOSETS
FOR PUPILS THROUGHOUT ALL BUILDINGS
ELEVATION OF W.C DOORS
SECTION
PLAN
SECTION
SECTION
DETAIL OF MANHOLE "D"
PLAN OF WATER CLOSETS · FOR · PUPILS
SECTION SHOWING METHOD OF CONDUCTING SURFACE WATER UNDER TUNNEL BETWEEN MODEL & NORMAL SCHOOLS
TUNNEL
PLAN
DETAIL OF ENGINEERS SHOWER IN PUMP ROOM
SCALE · DETAILS · OF · PLUMBING · FIXTURES.
INDEX
SECTION OF CATCH BASIN MARKED "A"
PLAN OF CATCH BASIN MARKED "A" "B" ON GROUP DRAWING NO 3
PLAN OF TOP
DETAIL OF CATCH BASINS IN BOYS PLAY YARD.
GALV IRON SINK
FRONT ELEVATION
SIDE ELEVATION
DETAIL OF SINK IN PUMP ROOM - LATIN SCHOOL.
1" SCALE DETAIL ENTRANCE OF WATER SUPPLY · LATIN · SCHOOL

DETAILS OF PLUMBING FIXTURES

NORMAL AND LATIN SCHOOL GROUP
BOSTON, MASS.

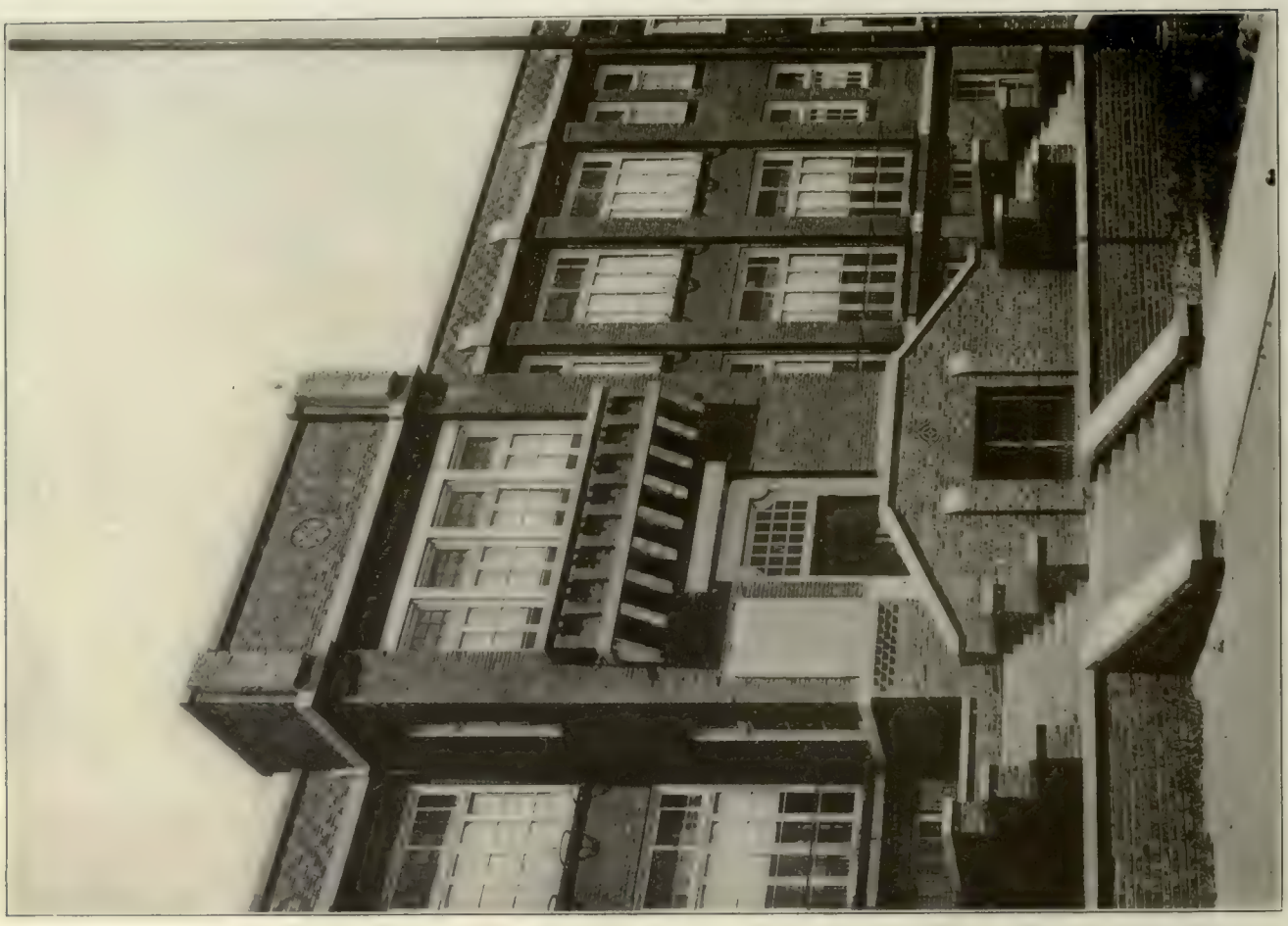
MESSRS. PEABODY & STEARNS, COOLIDGE & CARLSON AND MAGINNIS, WALSH & SULLIVAN, ASSOCIATED ARCHITECTS

WILLIAM B. ITTNER
ARCHITECT

M'KINLEY HIGH-SCHOOL
ST. LOUIS, MO.

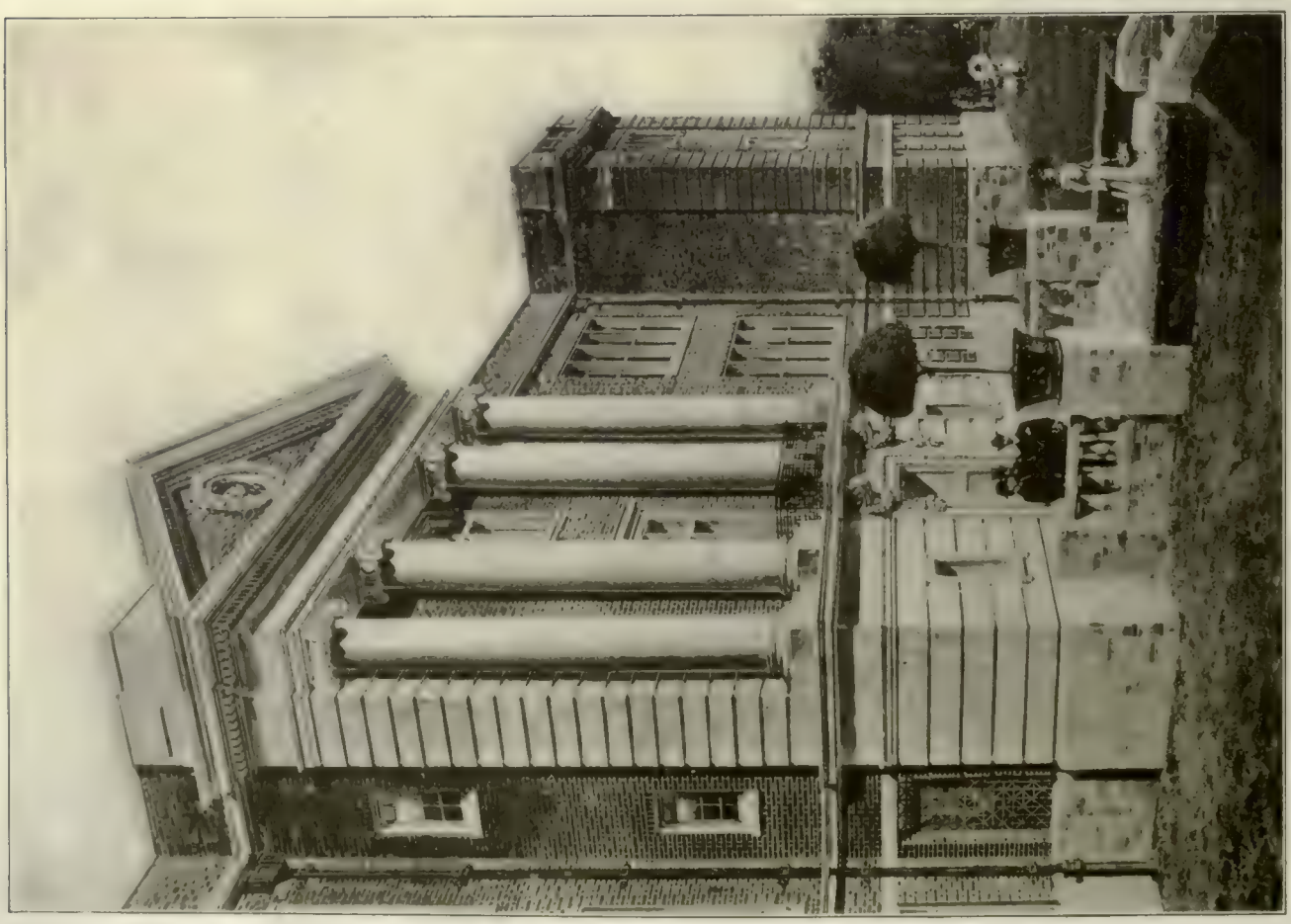
CLAY SCHOOL
ST. LOUIS, MO.

WILLIAM B. ITTNER
ARCHITECT



MAIN ENTRANCE, LAFAYETTE SCHOOL

WILLIAM B. ITTNER
ARCHITECT



MAIN ENTRANCE, CLAY SCHOOL

PUBLIC SCHOOL BUILDINGS
ST. LOUIS, MO.

PUBLIC SCHOOL BUILDINGS
ST. LOUIS, MO.

TEACHERS' COLLEGE

WILLIAM B. ITTNER
ARCHITECT

COTE BRILLIANTE SCHOOL AND FRANZ SIGEL SCHOOL
ST. LOUIS, MO.

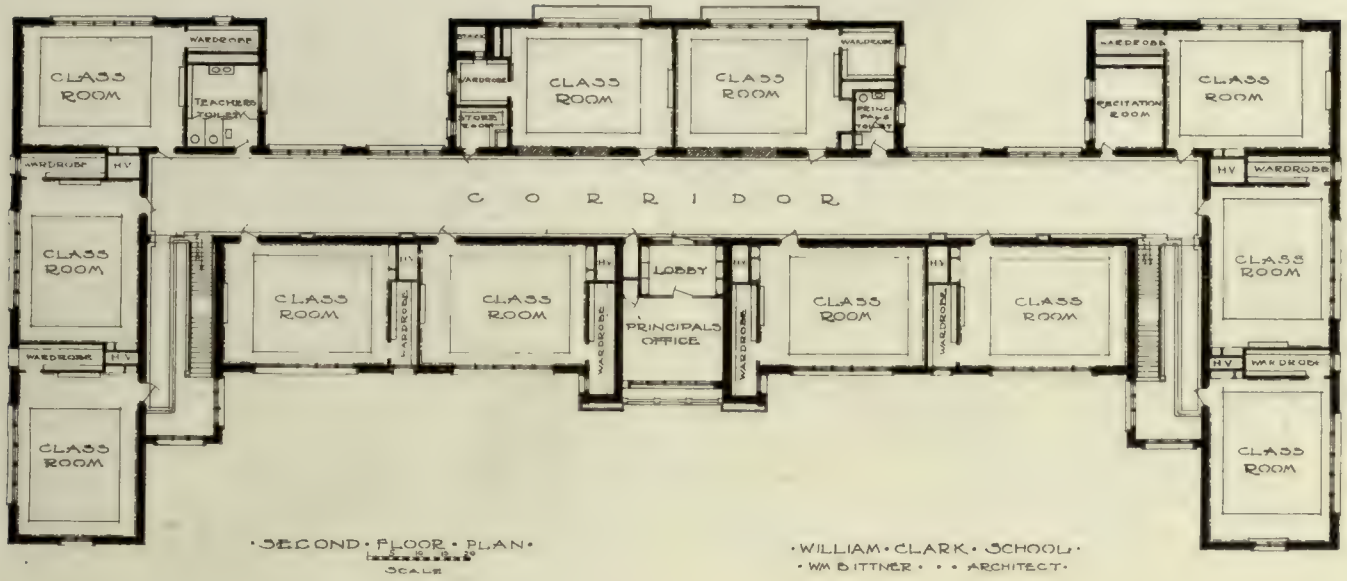
WILLIAM B. ITTNER
ARCHITECT

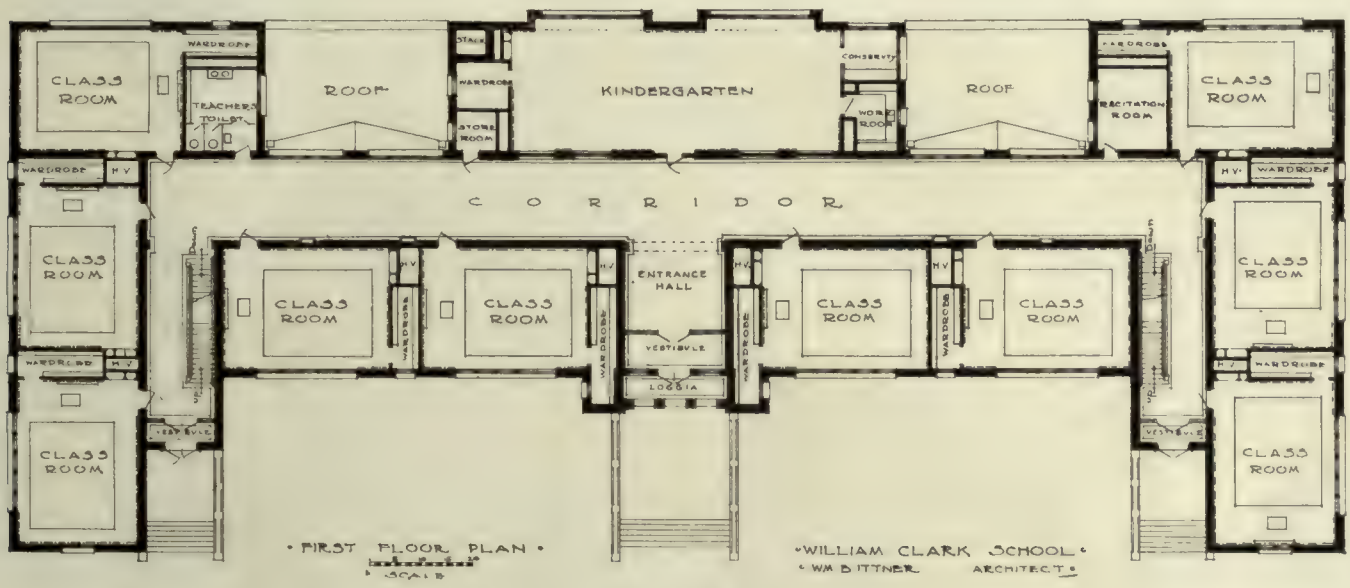
BLOW SCHOOL AND SHEPARD SCHOOL
ST. LOUIS, MO.

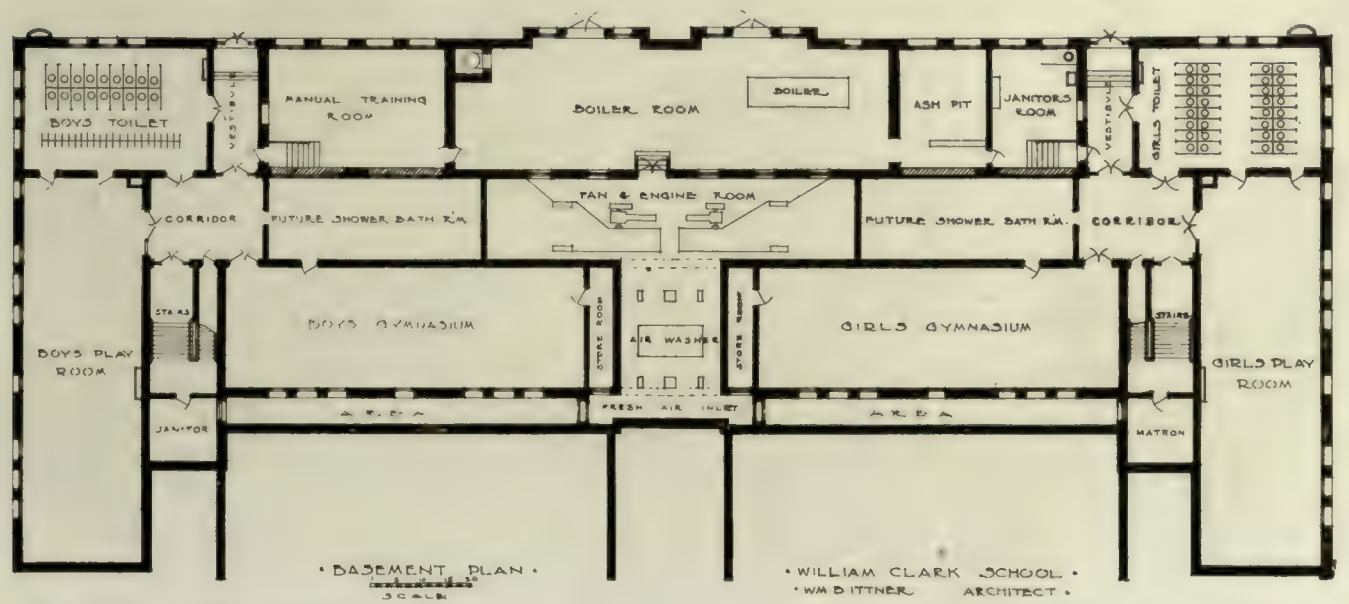
WILLIAM B. ITTNER
ARCHITECT

WILLIAM CLARK SCHOOL.
ST. LOUIS, MO.

WILLIAM B. ITTNER
ARCHITECT







WILLIAM CLARK SCHOOL
ST. LOUIS, MO.

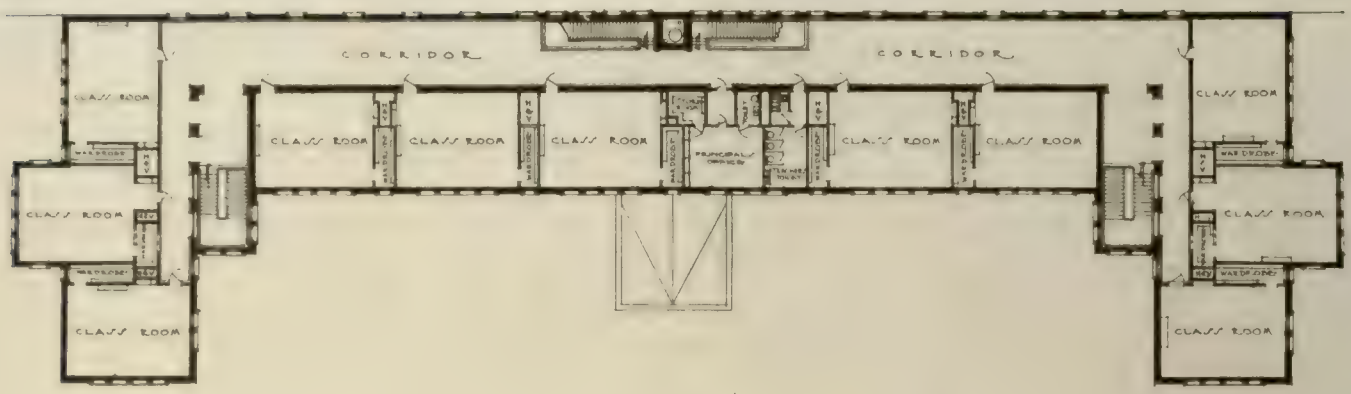
WILLIAM B. ITTNER
ARCHITECT

PATRICK HENRY SCHOOL
ST. LOUIS, MO.

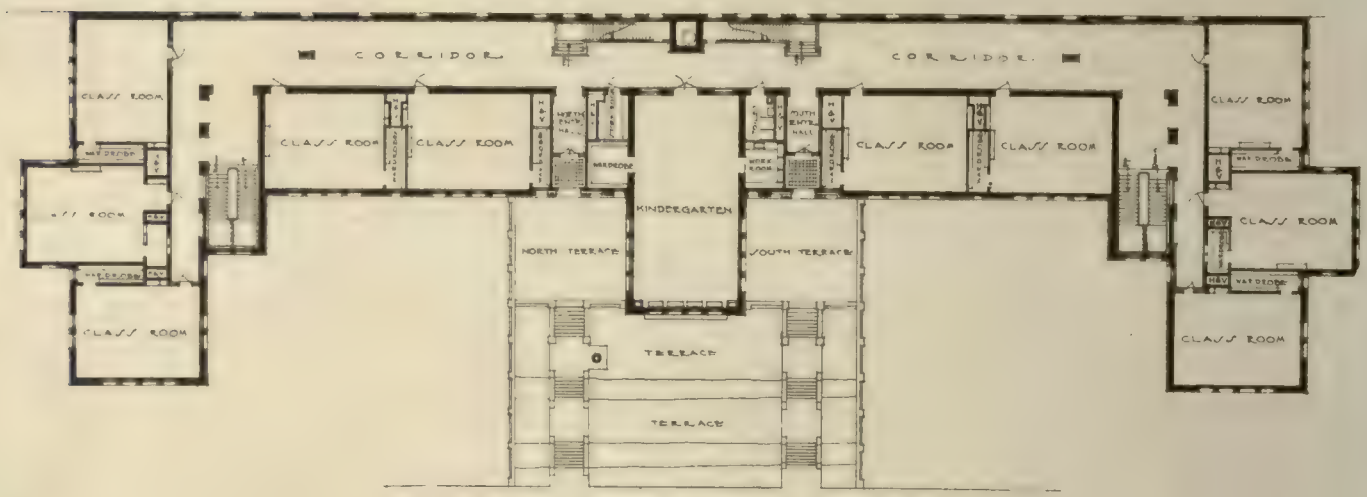
WILLIAM B. ITTNER
ARCHITECT

PATRICK HENRY SCHOOL
ST. LOUIS, MO.

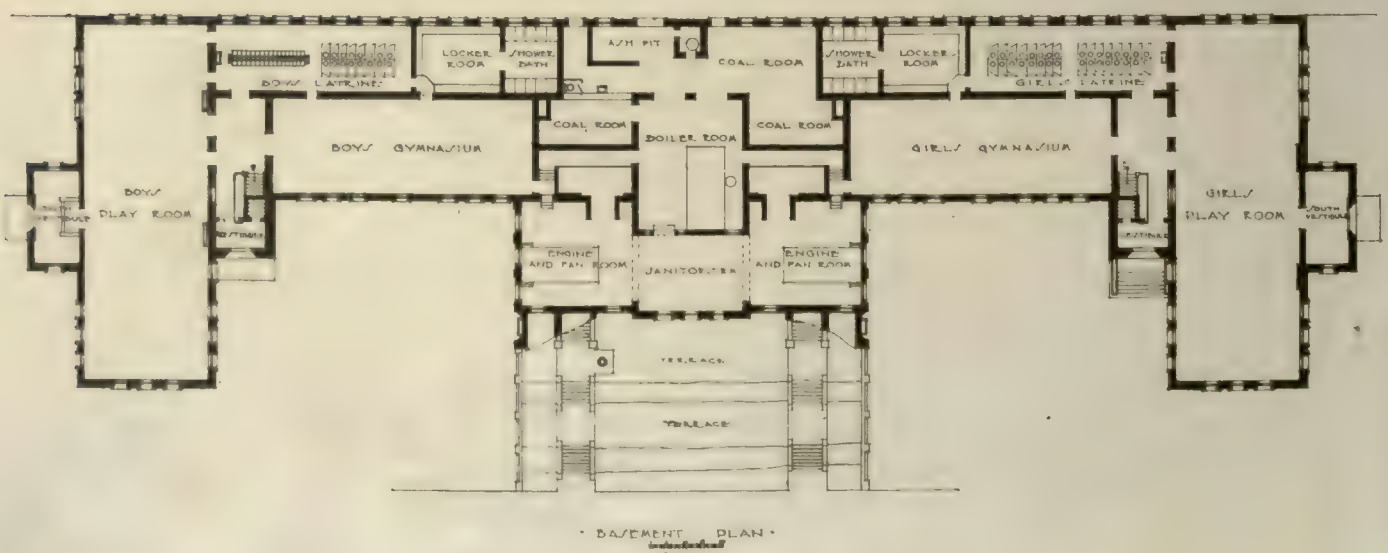
WILLIAM B. ITTNER
ARCHITECT



SECOND FLOOR PLAN.



FIRST FLOOR PLAN



BASEMENT PLAN

PATRICK HENRY SCHOOL
ST. LOUIS, MO.

WILLIAM B. ITTNER
ARCHITECT

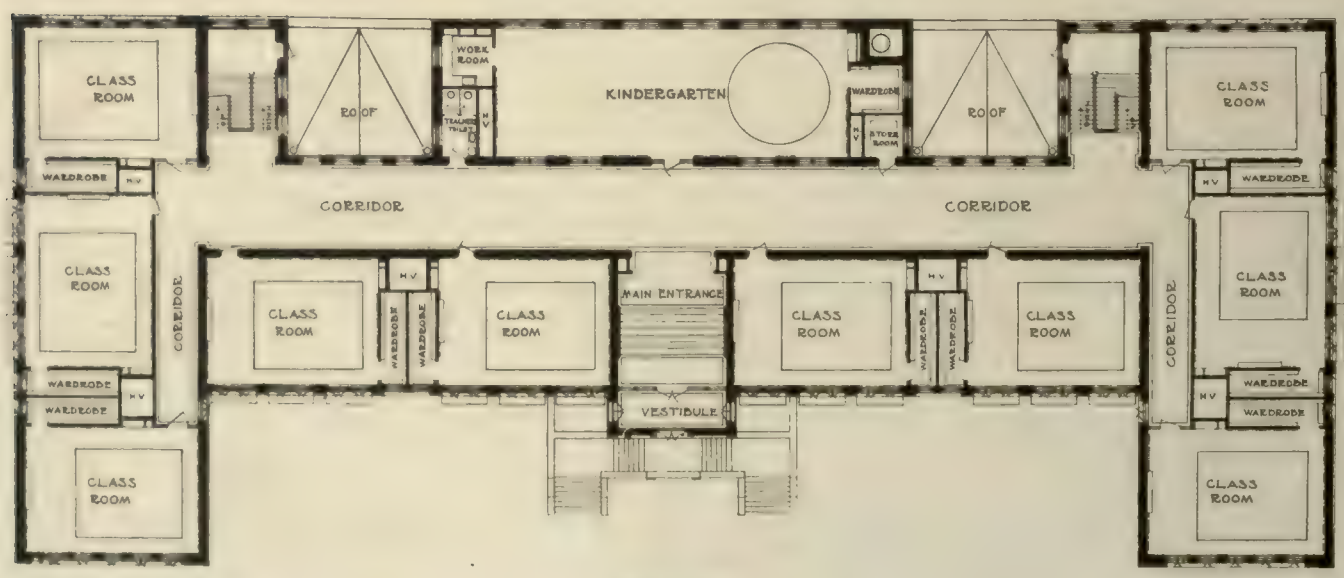
MAIN CORRIDOR

LAFAYETTE SCHOOL
ST. LOUIS, MO.

CONCRETE STAIRWAY

WILLIAM B. ITTNER
ARCHITECT

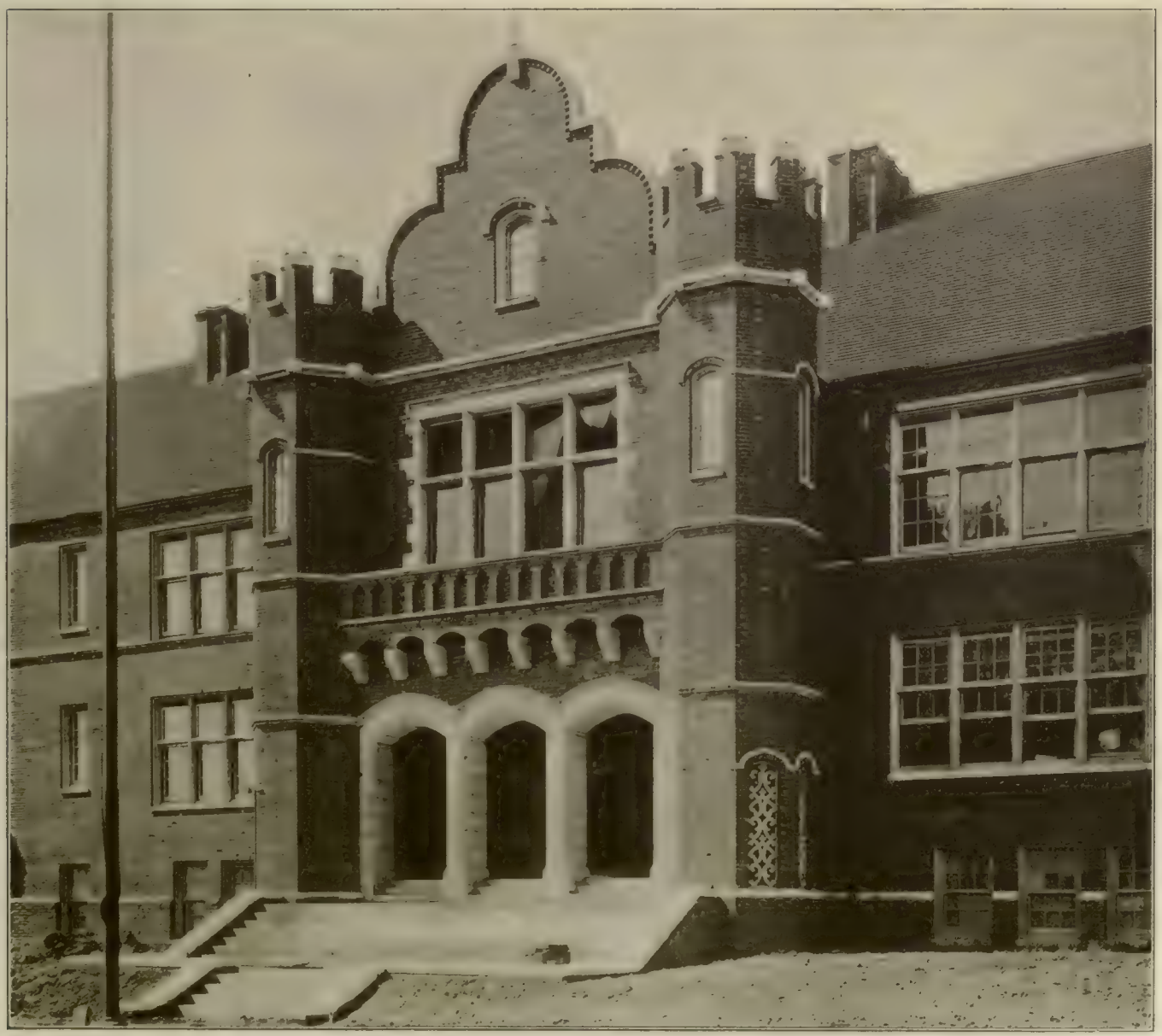
SECOND FLOOR



FIRST FLOOR

LAFAYETTE SCHOOL
ST. LOUIS, MO.

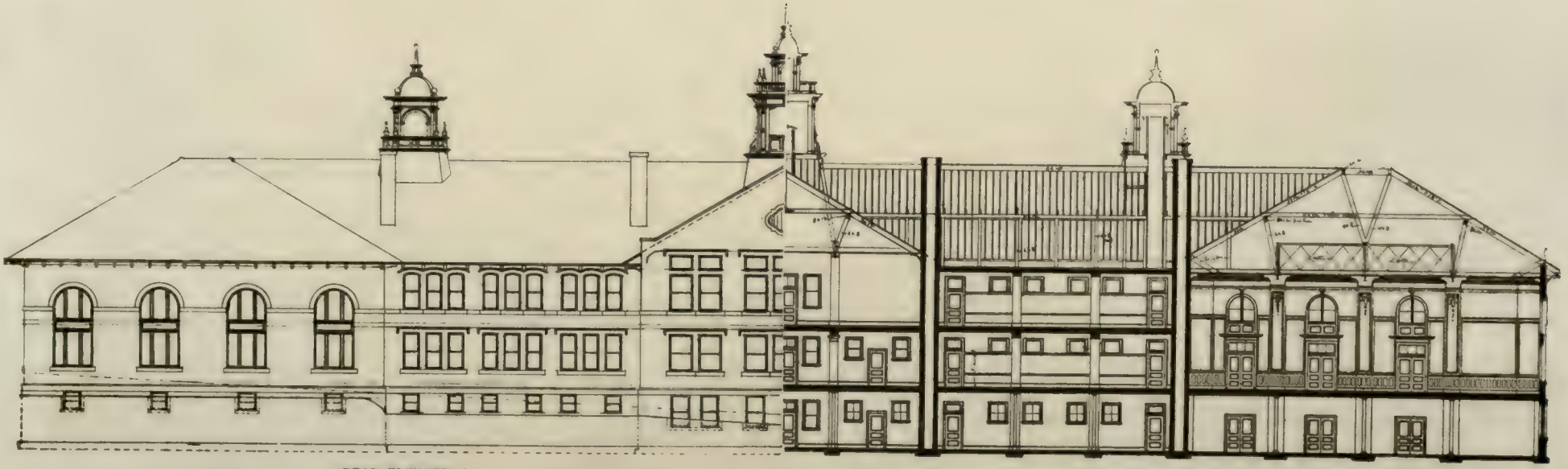
WILLIAM B. ITTNER
ARCHITECT



EDWARD HEMPSTEAD SCHOOL
ST. LOUIS, MO.

WILLIAM B. ITTNER
ARCHITECT

PERSPECTIVE VIEW

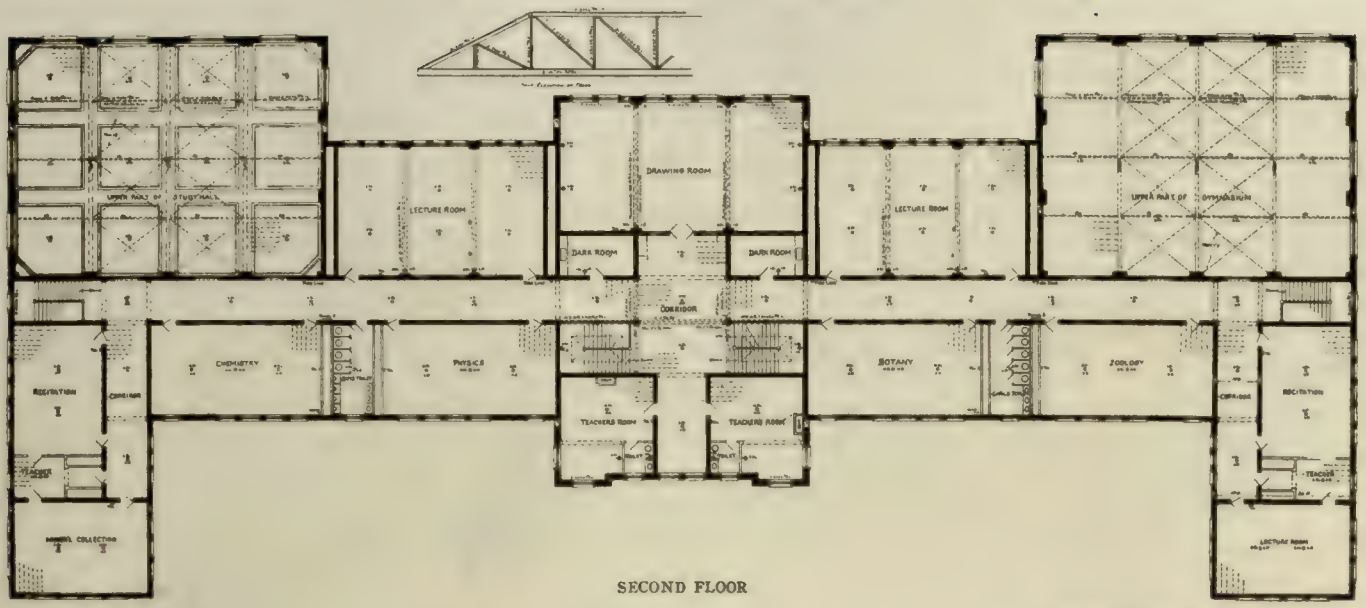


REAR ELEVATION

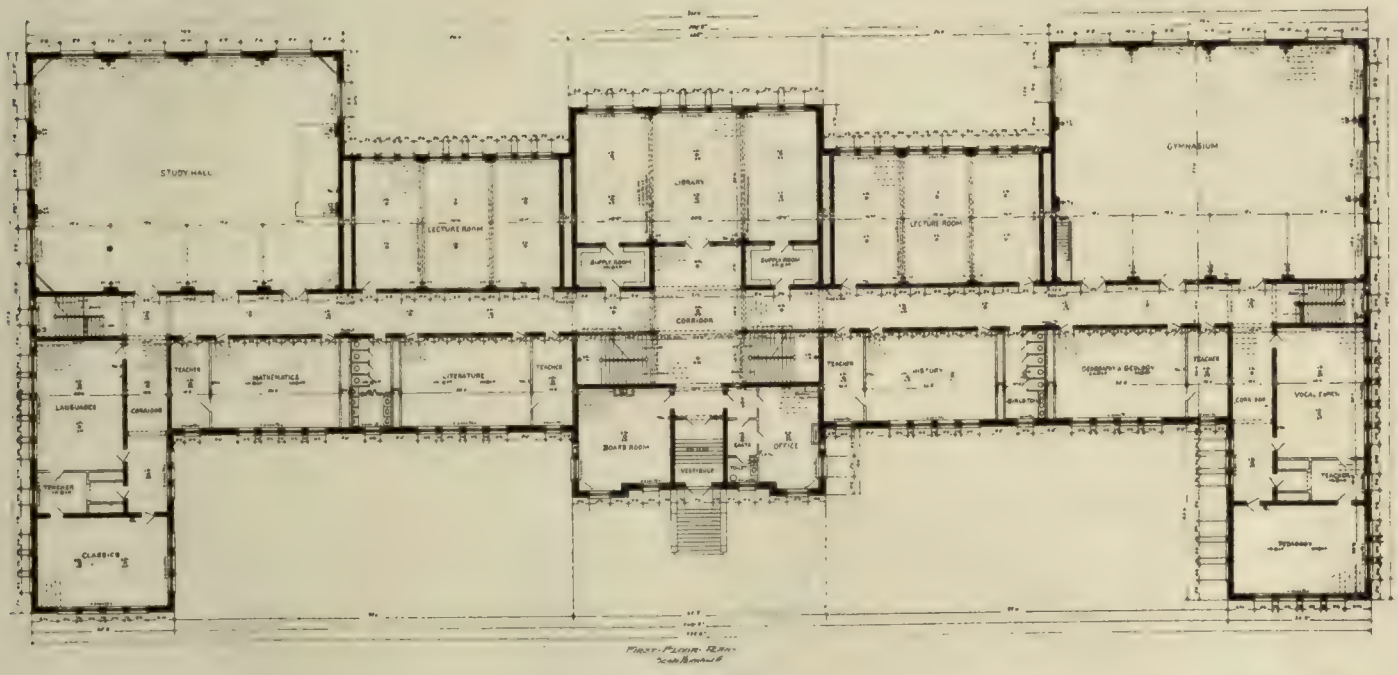
LONGITUDINAL SECTION

NEW JERSEY STATE NORMAL SCHOOL
MONTCLAIR HEIGHTS, N. J.

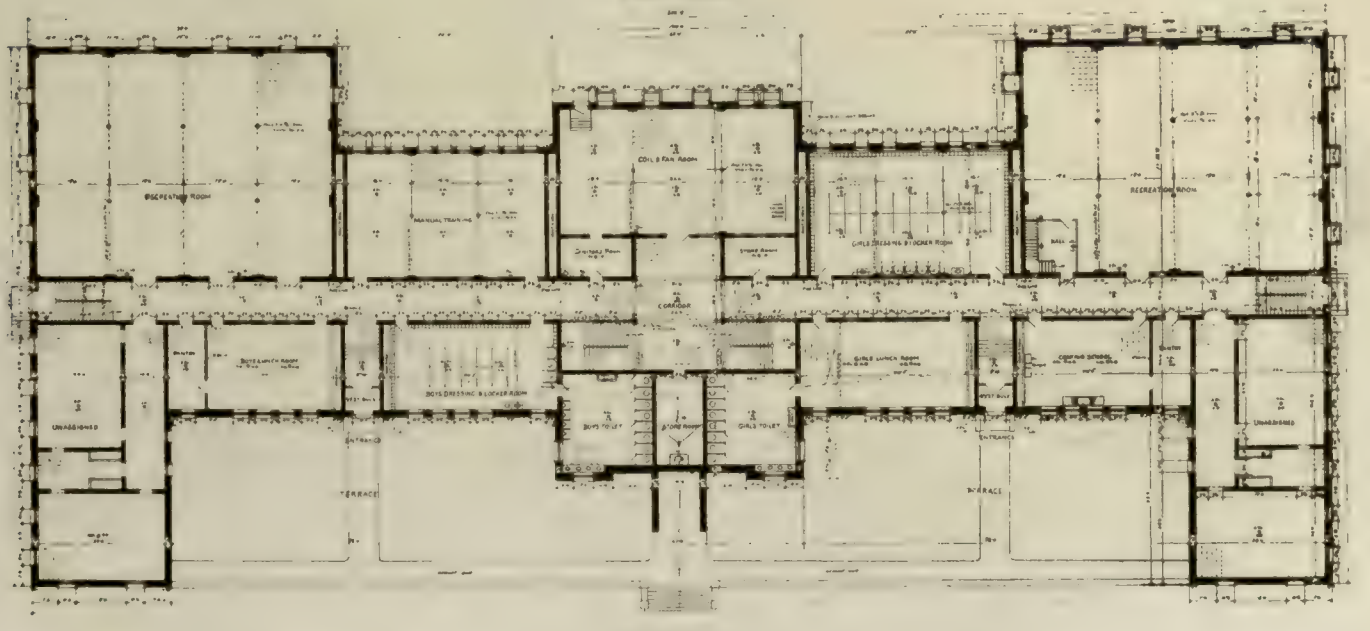
GEORGE E. POOLE, STATE ARCHITECT
FRANCIS H. BENT, ASSISTANT



SECOND FLOOR



FIRST FLOOR



BASEMENT

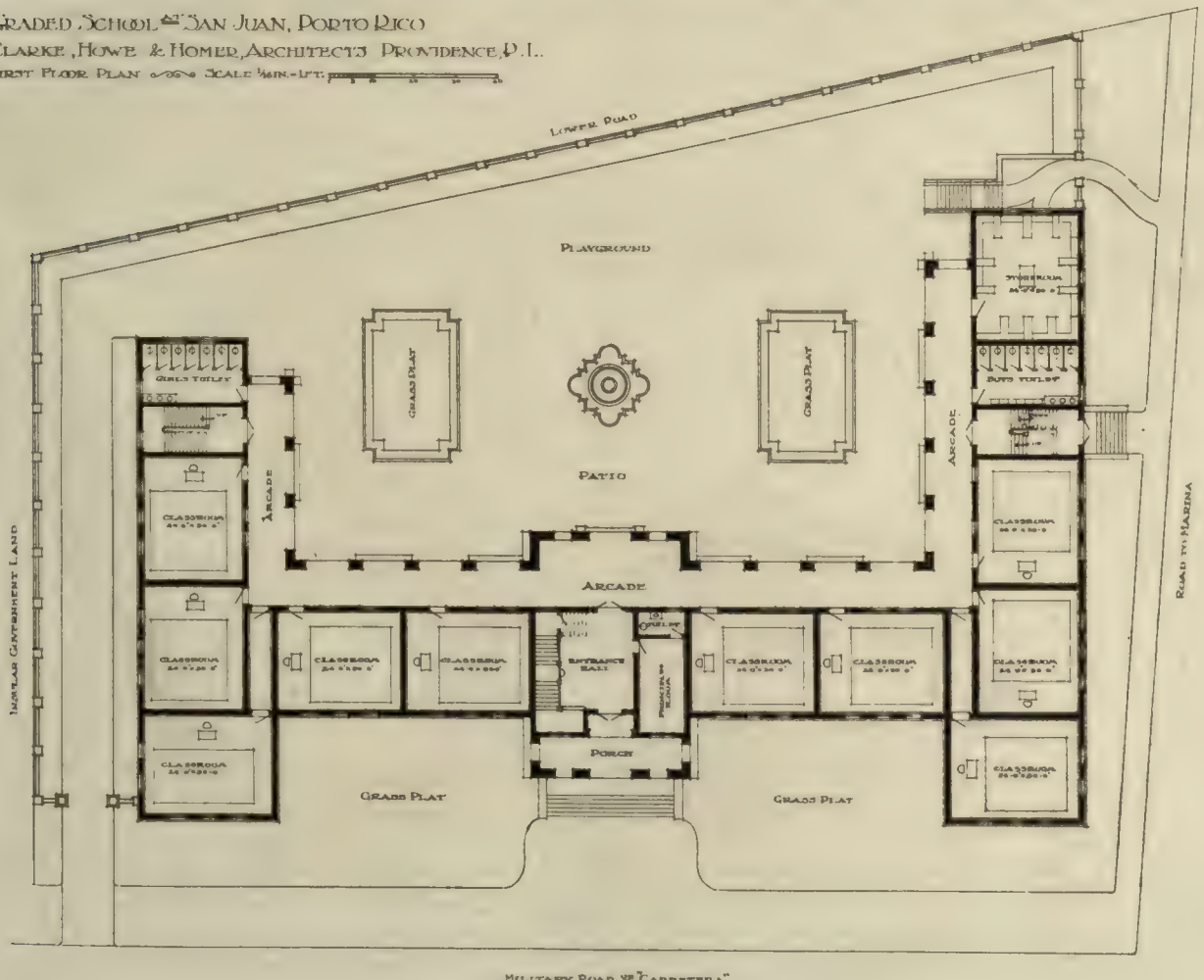
NEW JERSEY STATE NORMAL SCHOOL
MONTCLAIR HEIGHTS, N. J.

GEORGE E. POOLE, STATE ARCHITECT
FRANCIS H. BENT, ASSISTANT

SCHOOL BUILDING
HINCKLEY, MAINE

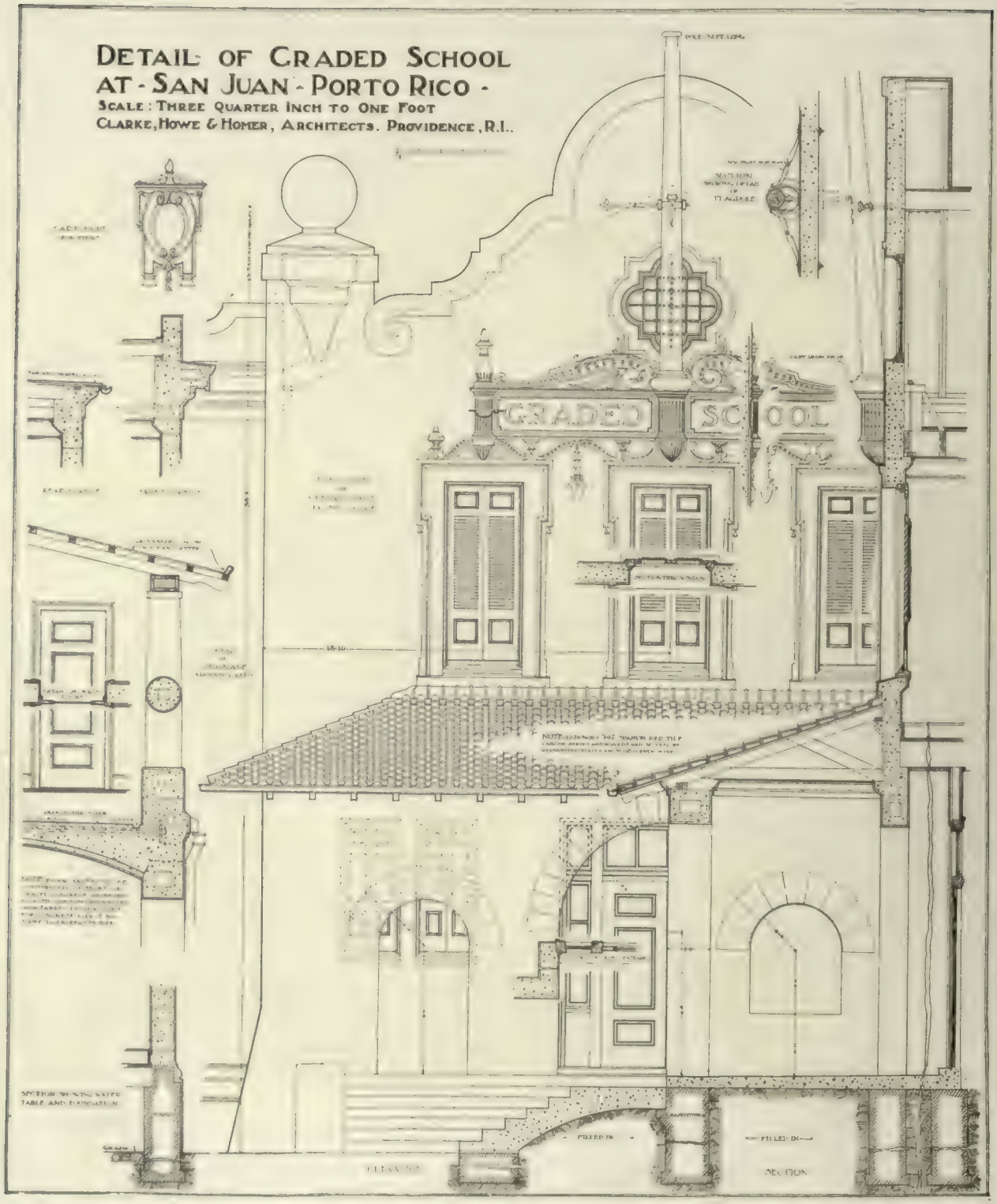
FRANK A. BOURNE
ARCHITECT

GRADED SCHOOL — SAN JUAN, PORTO RICO
CLARKE, HOWE & HOMER, ARCHITECTS PROVIDENCE, R.I.
FIRST FLOOR PLAN SCALE 1/16 IN. = 1 FT.



GRADED SCHOOL
SAN JUAN, PORTO RICO

MESSRS. CLARKE, HOWE & HOMER
ARCHITECTS

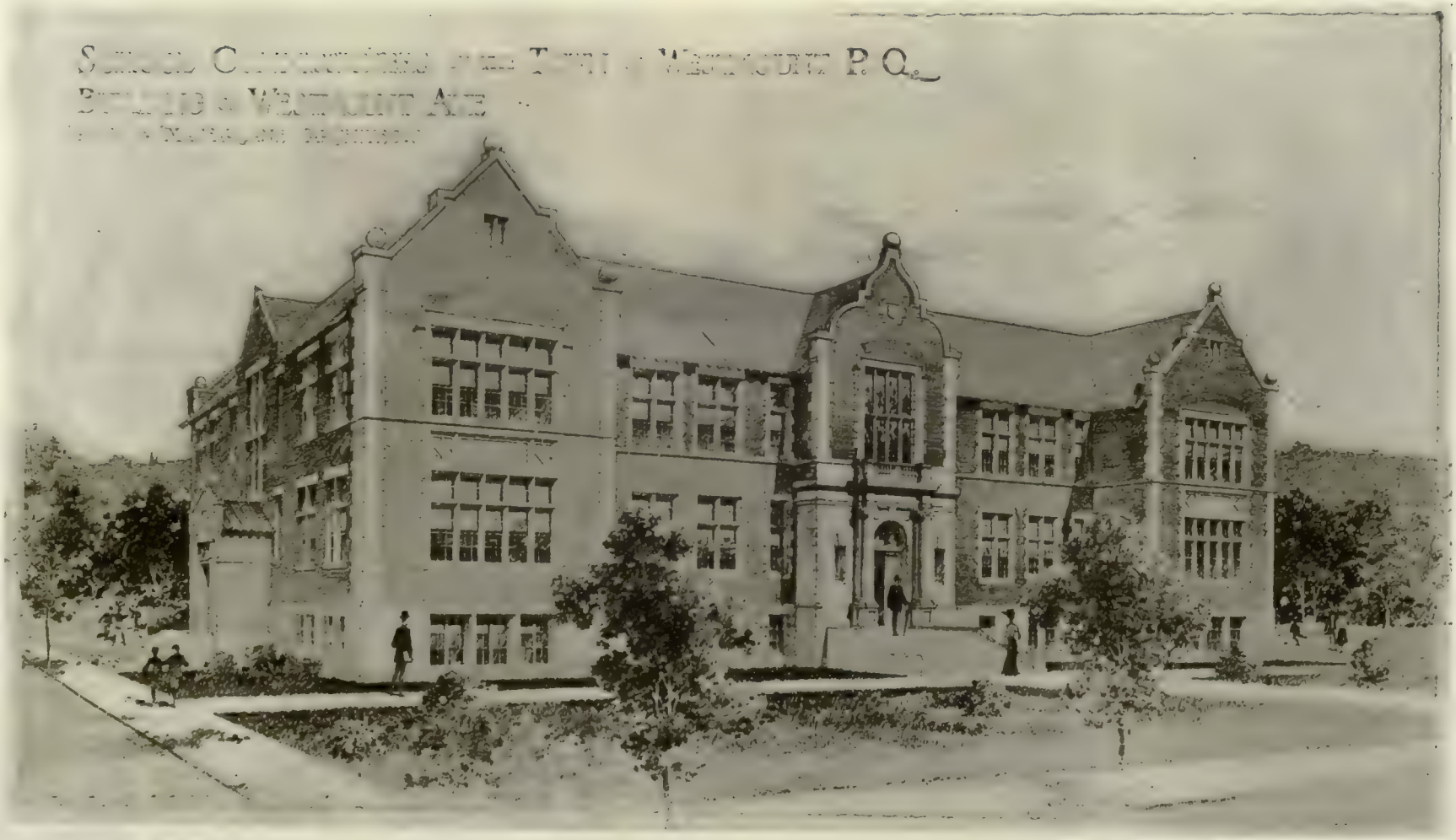

DETAIL OF GRADED SCHOOL
AT - SAN JUAN - PORTO RICO -
SCALE : THREE QUARTER INCH TO ONE FOOT
CLARKE, HOWE & HOMER, ARCHITECTS. PROVIDENCE, R.I..
GRADED SCHOOL
SECTION

GRADED SCHOOL
SAN JUAN, PORTO RICO

MESSRS. CLARKE, HOWE & HOMER
ARCHITECTS

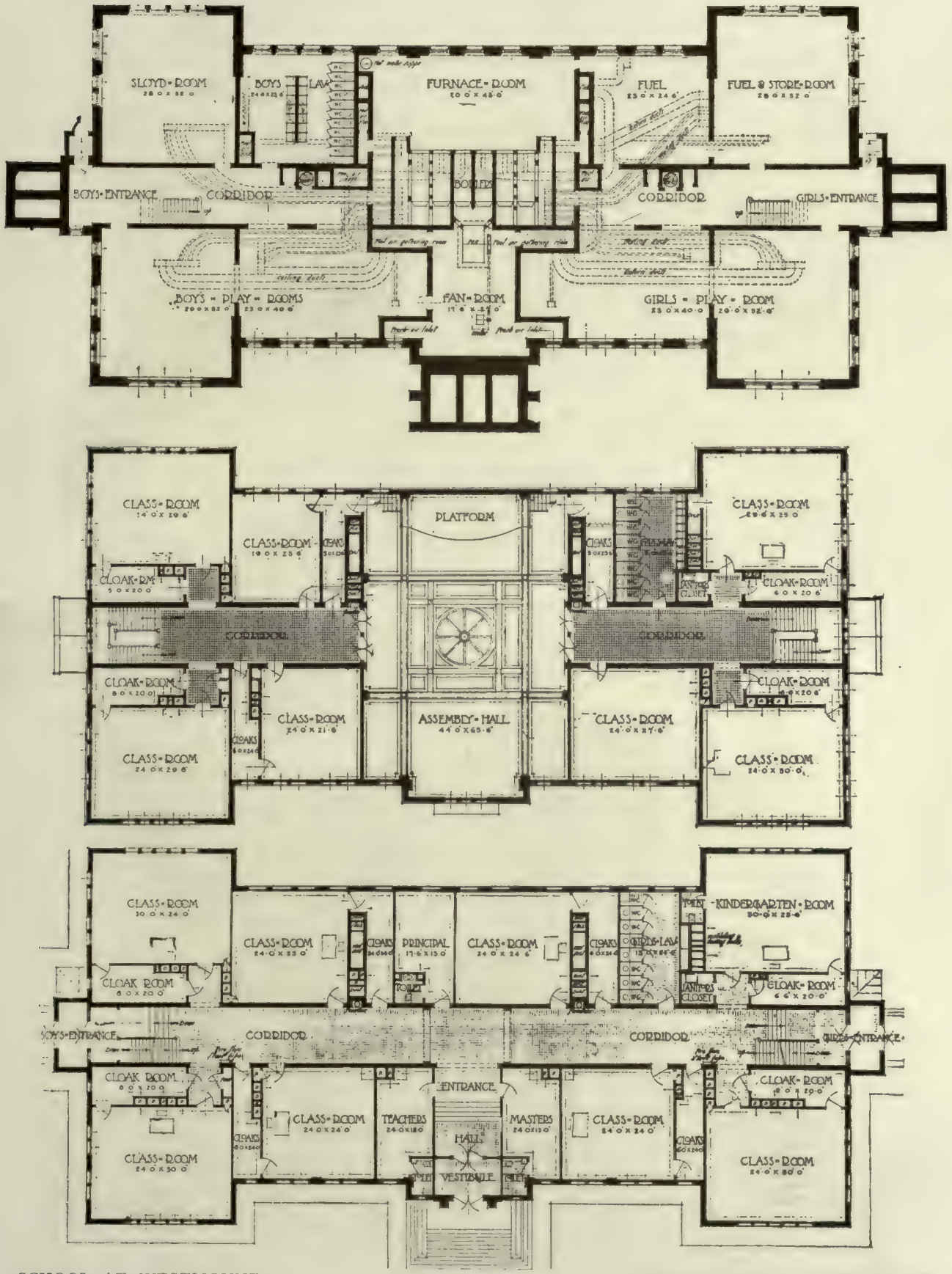
EAST END SCHOOL
CLEVELAND, OHIO

MESSRS. HUBBELL & BENES
ARCHITECTS



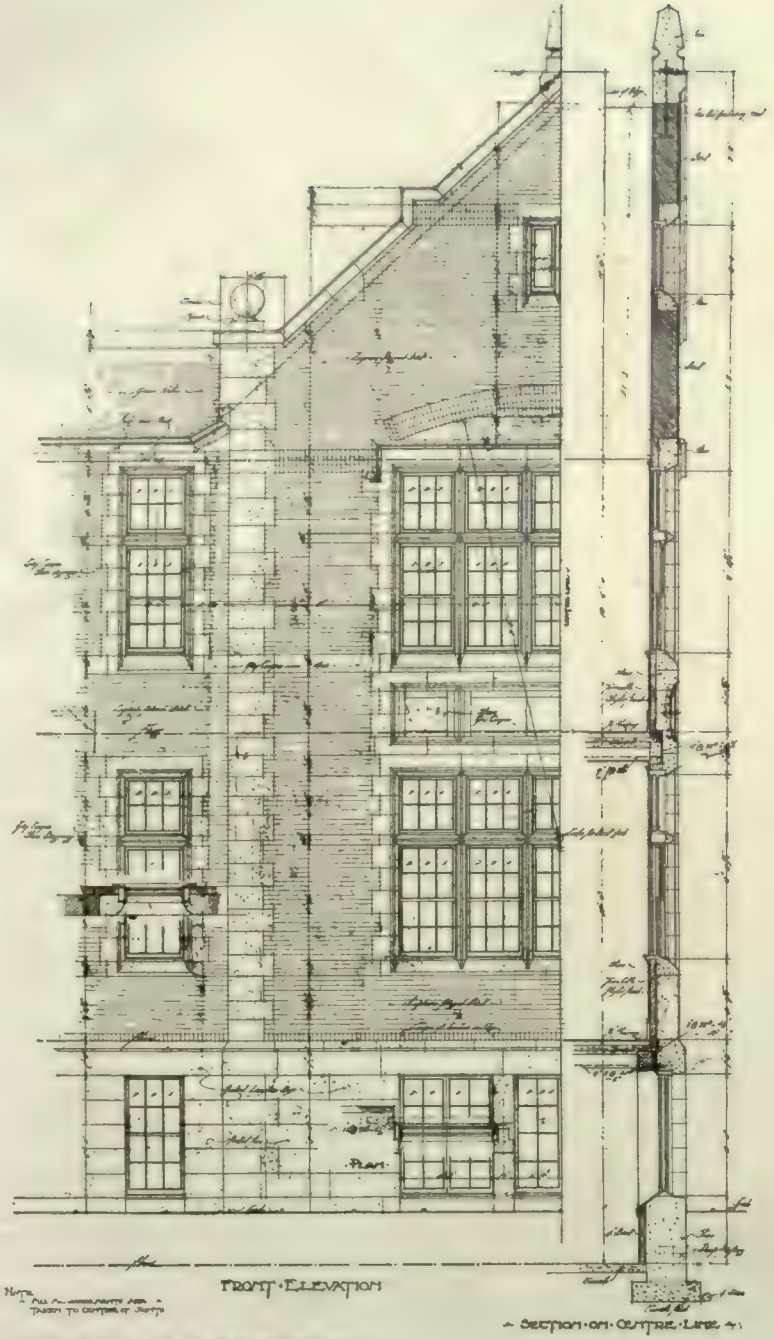
SCHOOL AT WESTMOUNT
PROVINCE OF QUEBEC, CANADA

MESSRS. ROSS & MACFARLANE
ARCHITECTS

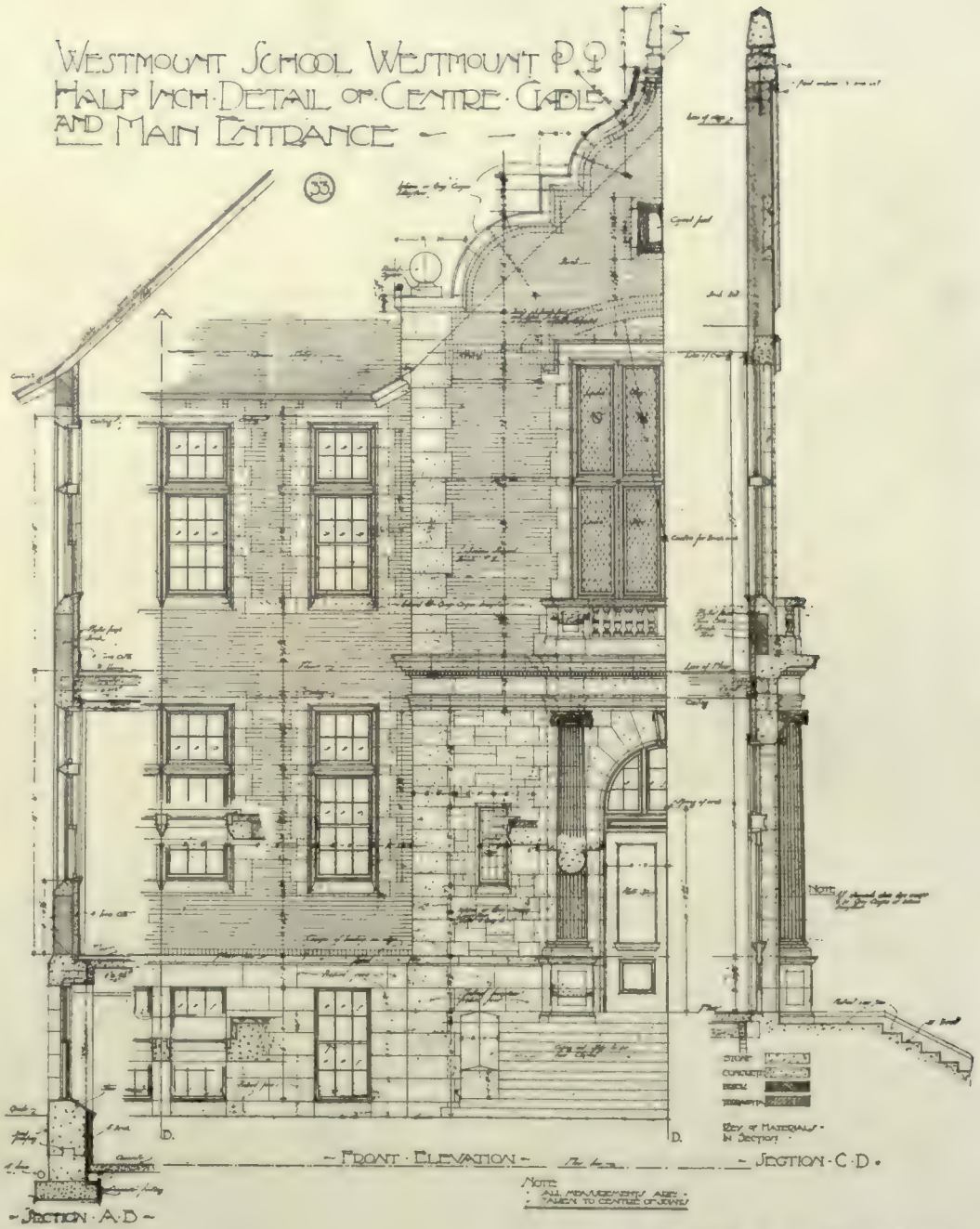


SCHOOL AT WESTMOUNT
PROVINCE OF QUEBEC, CANADA

MESSRS. ROSS & MACFARLANE
ARCHITECTS



SCHOOL AT WESTMOUNT
PROVINCE OF QUEBEC, CANADA


WESTMOUNT SCHOOL WESTMOUNT P.Q.
HALF INCH DETAIL OF CENTRE GABLE AND MAIN ENTRANCE
FRONT · ELEVATION
SECTION · C · D ·
SECTION · A · D ·
NOTE
ALL MEASUREMENTS ARE TAKEN TO CENTRE OF JOISTS

MESSRS. ROSS & MACFARLANE
ARCHITECTS

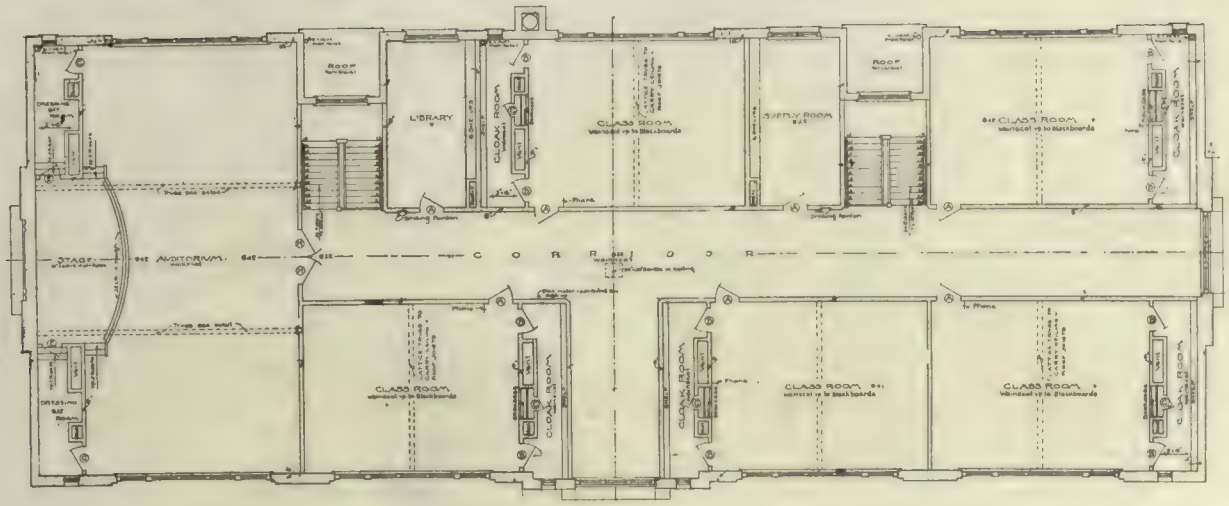
FIFTH WARD SCHOOL
ATLANTA, GA.

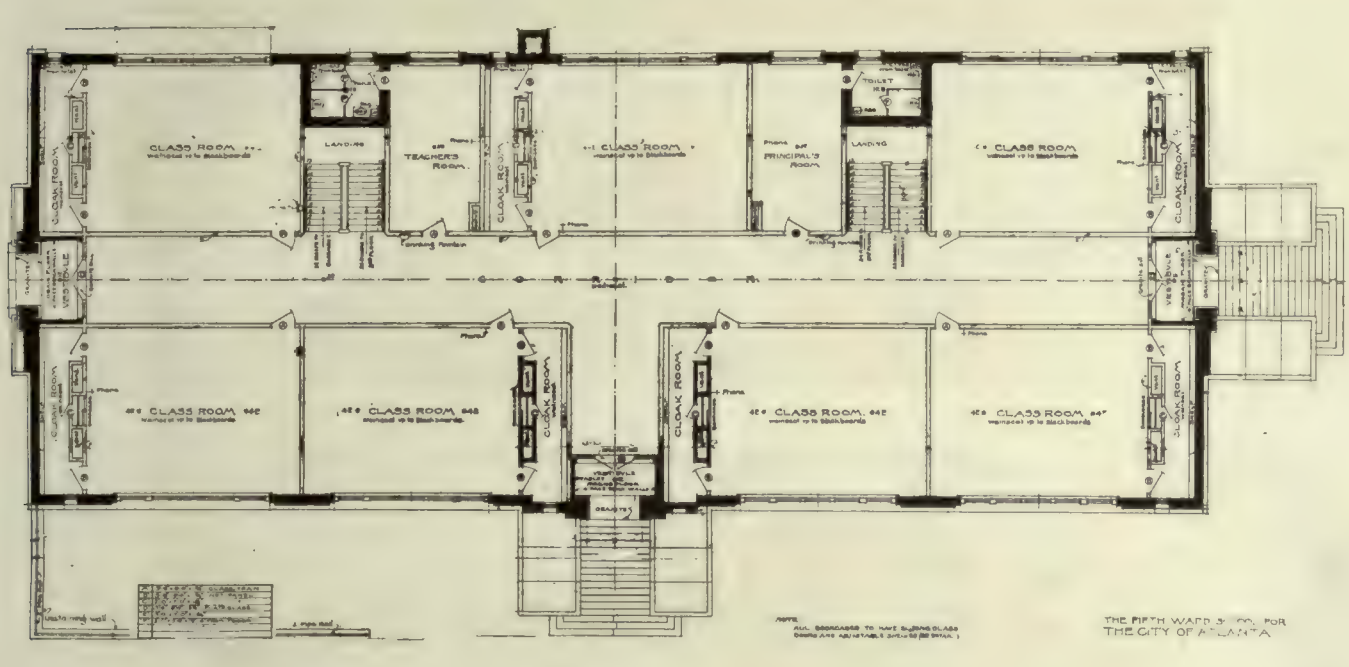
MR. HARALSON BLECKLEY
ARCHITECT

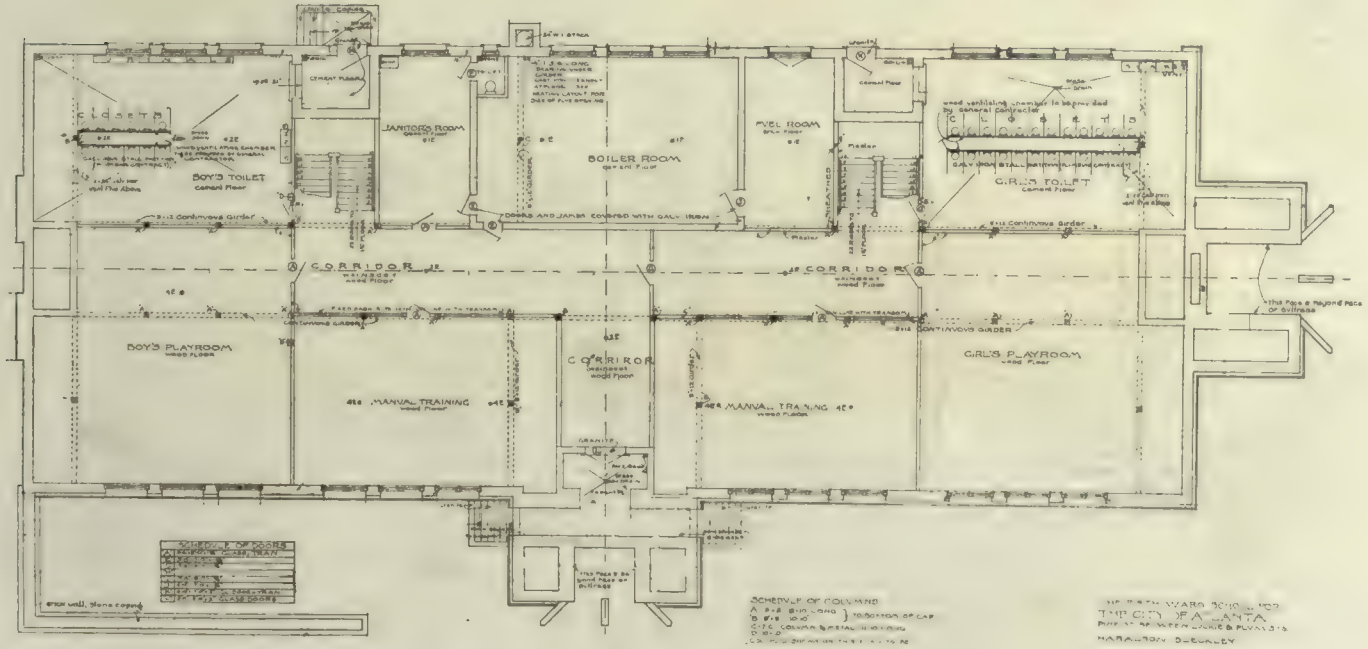
MR. HARALSON BLECKLEY
ARCHITECT

ENTRANCE DETAILS

FIFTH WARD SCHOOL
ATLANTA, GA.





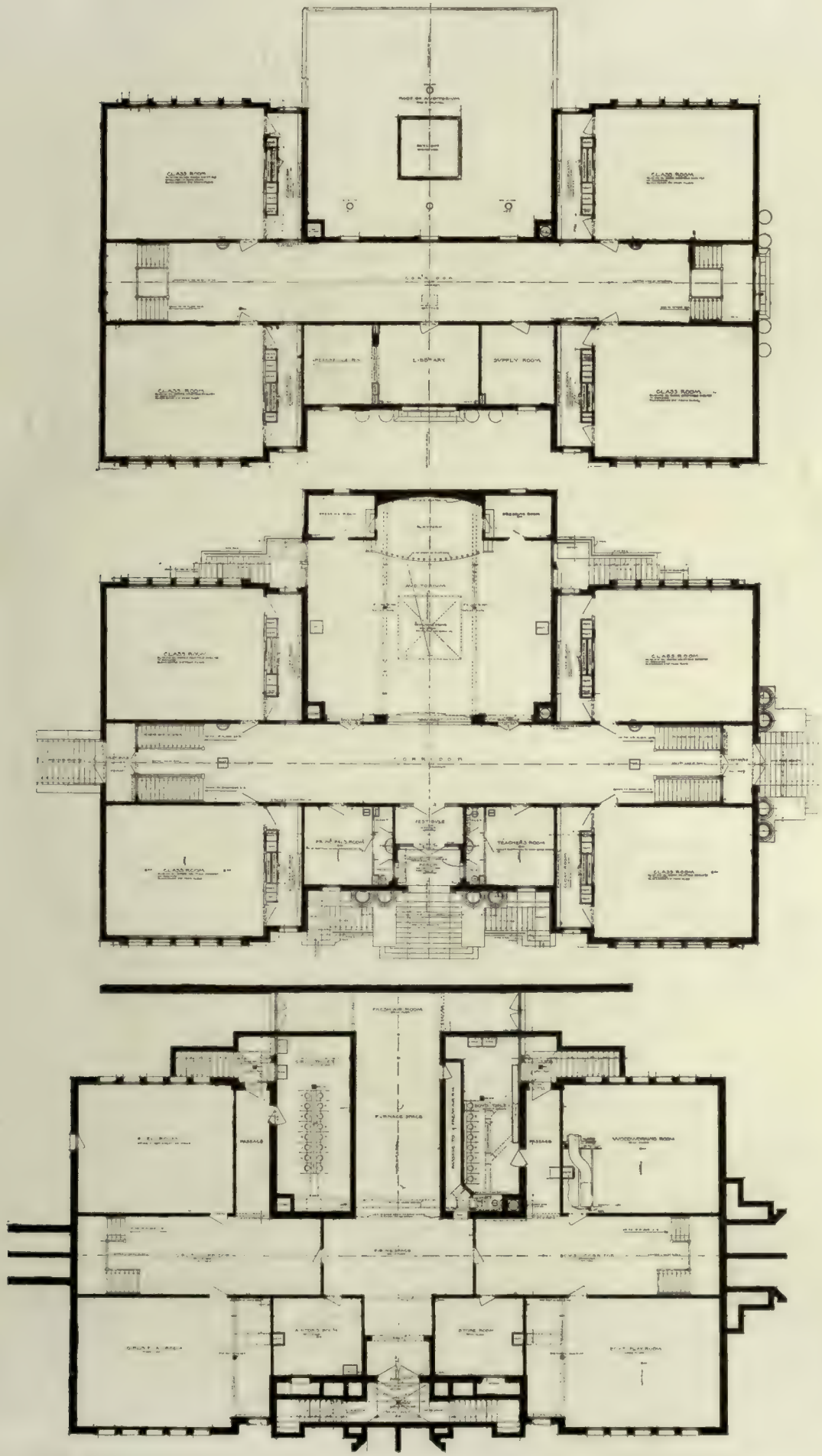


FIFTH WARD SCHOOL
ATLANTA, GA.

MR. HARALSON BLECKLEY
ARCHITECT

SECOND WARD SCHOOL
ATLANTA, GA.

MR. HARALSON BLECKLEY
ARCHITECT

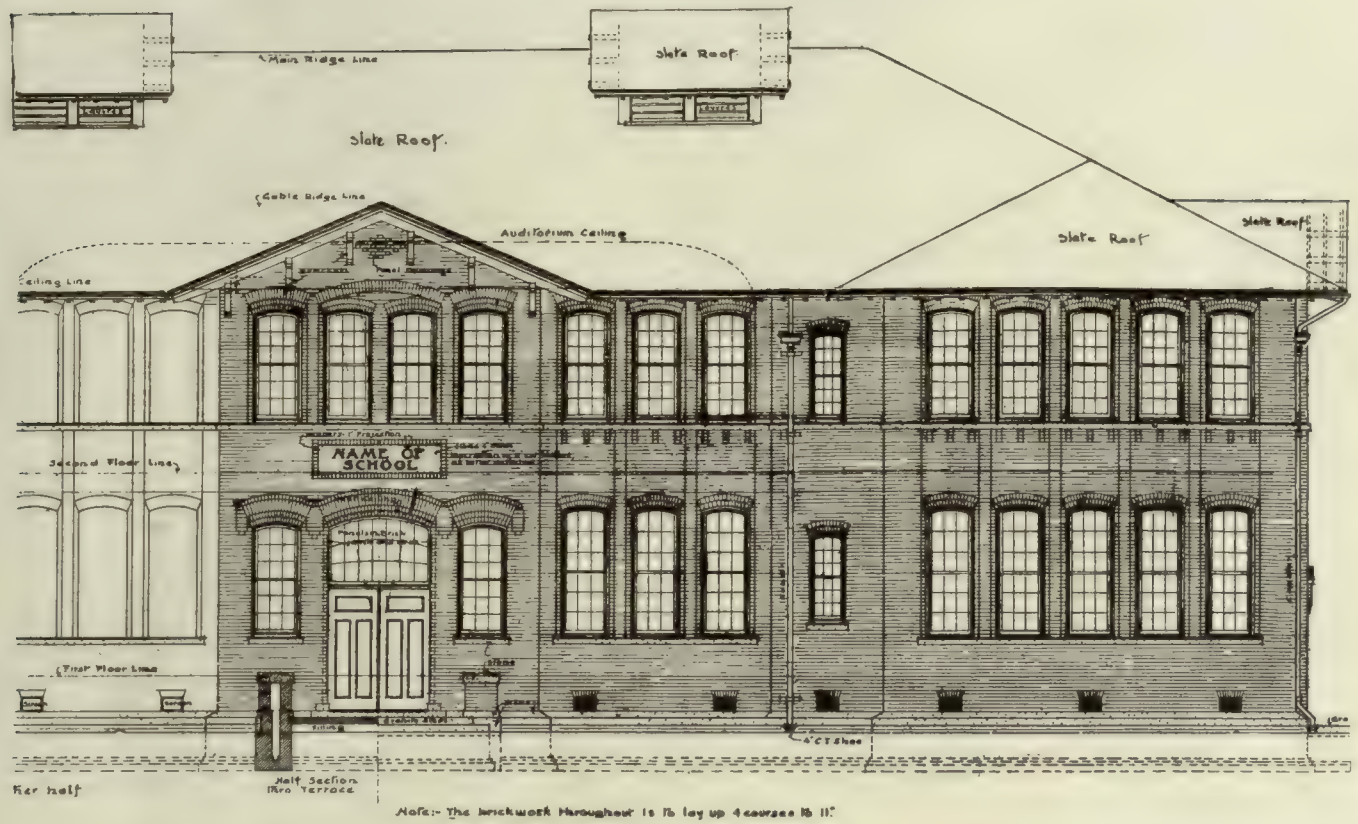


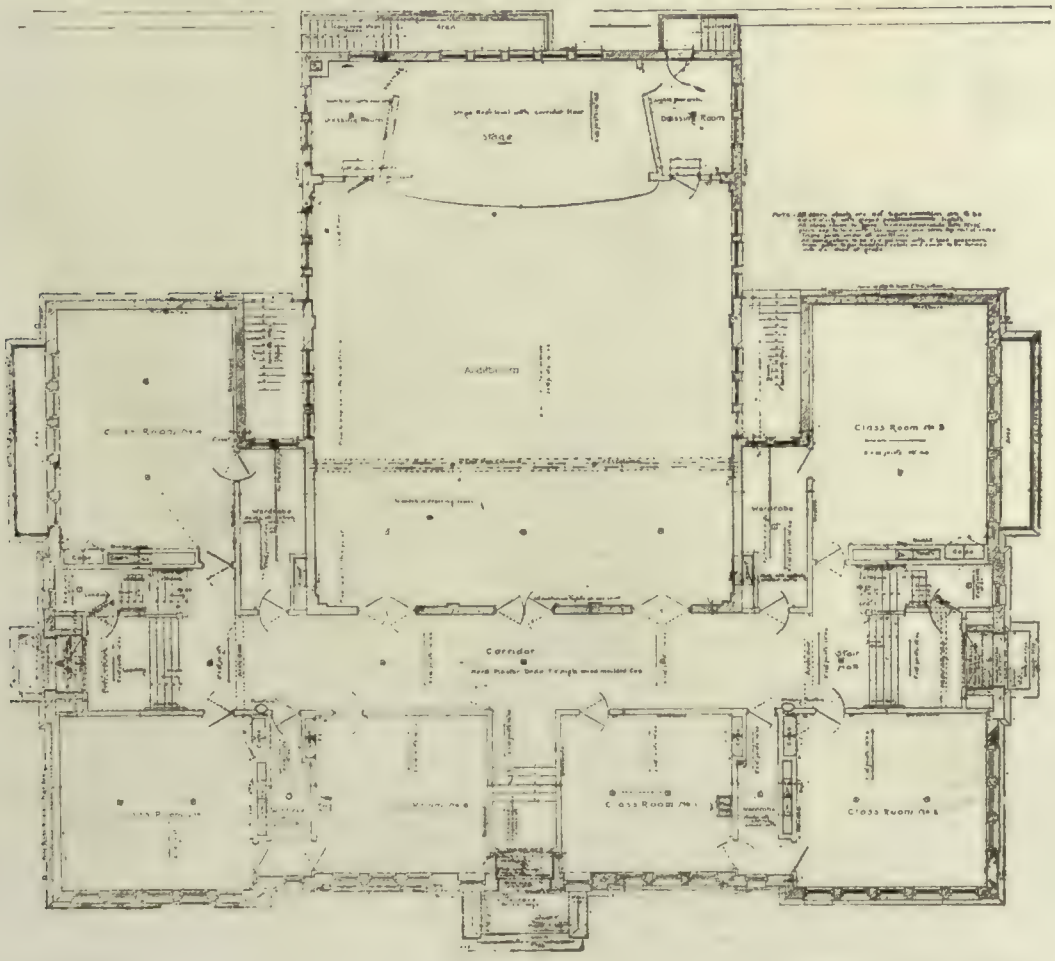
SECOND WARD SCHOOL
ATLANTA, GA.

MR. HARALSON BLECKLEY
ARCHITECT

GRADED SCHOOL
MANNING, S. C.

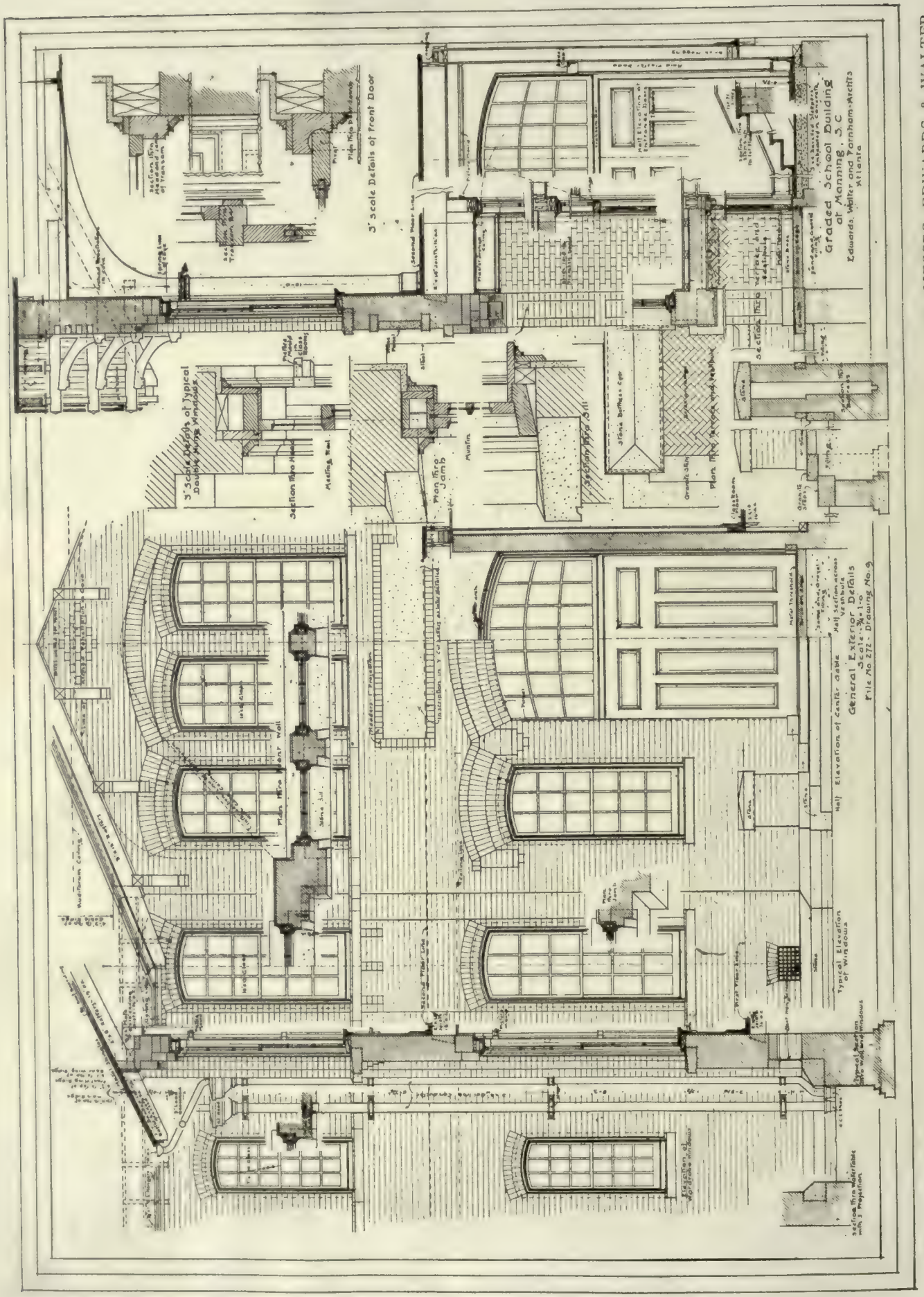
MESSRS. EDWARDS & WALTER
ARCHITECTS





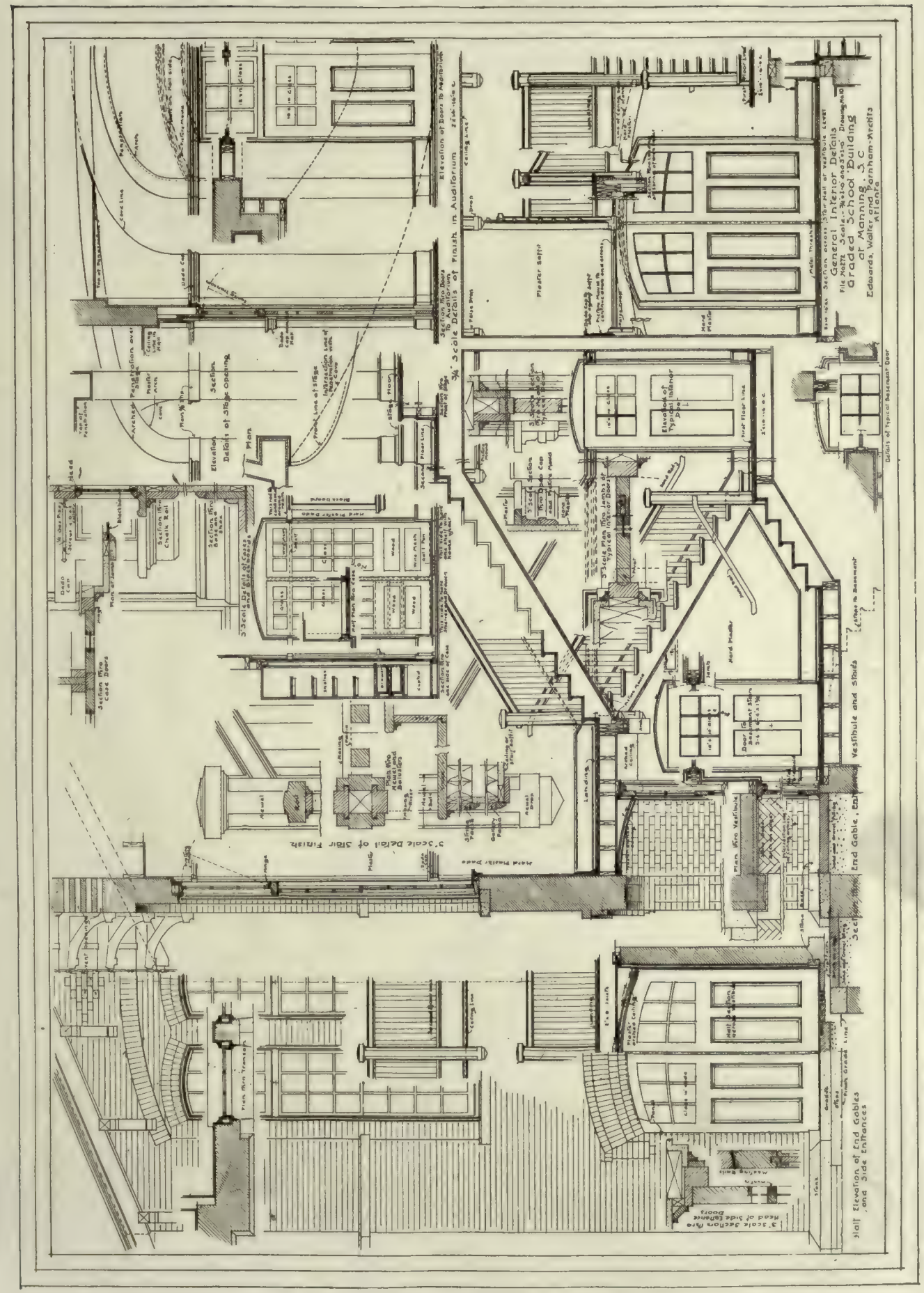
GRADED SCHOOL
MANNING, S. C.

MESSRS. EDWARDS & WALTER
ARCHITECTS


Graded School Building at Manning, S.C.
Edwards, Walter and Farnham-Architects Atlanta
3" Scale Details of Front Door
3" Scale Details of Typical Double Hung Windows
General Exterior Details
Scale: 3/16-1-0
File No. 272 - Drawing No. 9
Typical Elevation of Windows

MESSRS. EDWARDS & WALTER
ARCHITECTS

GRADED SCHOOL
MANNING, S. C.

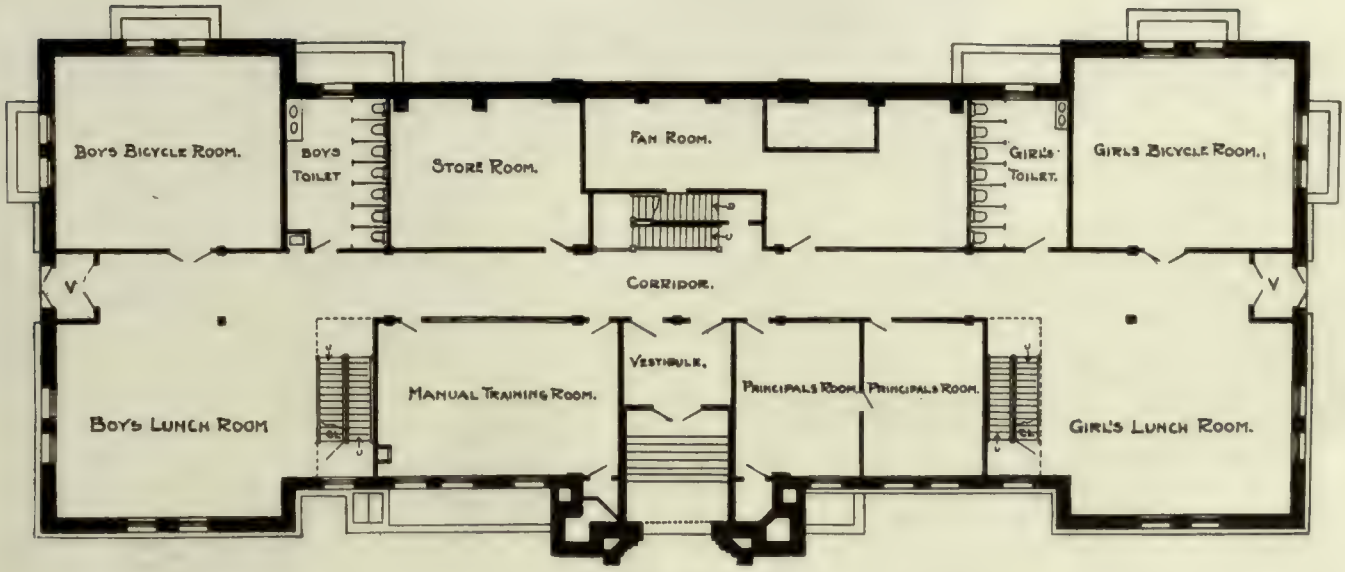

General Interior Details
Graded School Building
of Manning, S.C.
Edwards, Walter and Parnham-Architects
Elevation of Doors to Auditorium
3/4" Scale Details of Finish in Auditorium
Details of Stage opening
Plan
Elevation
3" Scale Plan thru Jambs of typical Interior Door
3" Scale Section thru Head of typical Interior Door
3" Scale Details of Cases and Blackboards
3" Scale Detail of Stair Finish
Vestibule and Stairs
End Gable, Entrance
Section thru Head of Side Entrance Doors
Half Elevation of End Gables and Side Entrances
GRADED SCHOOL
MANNING, S. C.
MESSRS. EDWARDS & WALTER
ARCHITECTS

CURTIS HIGH-SCHOOL, RICHMOND

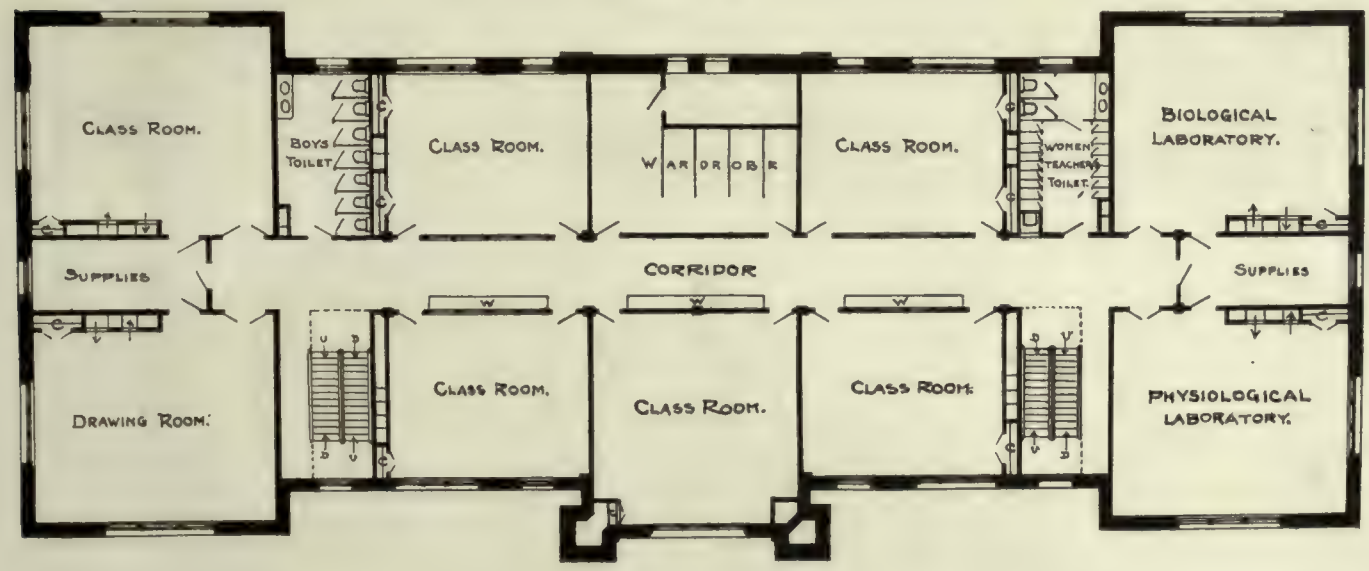
ENTRANCE: CURTIS HIGH-SCHOOL, RICHMOND

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

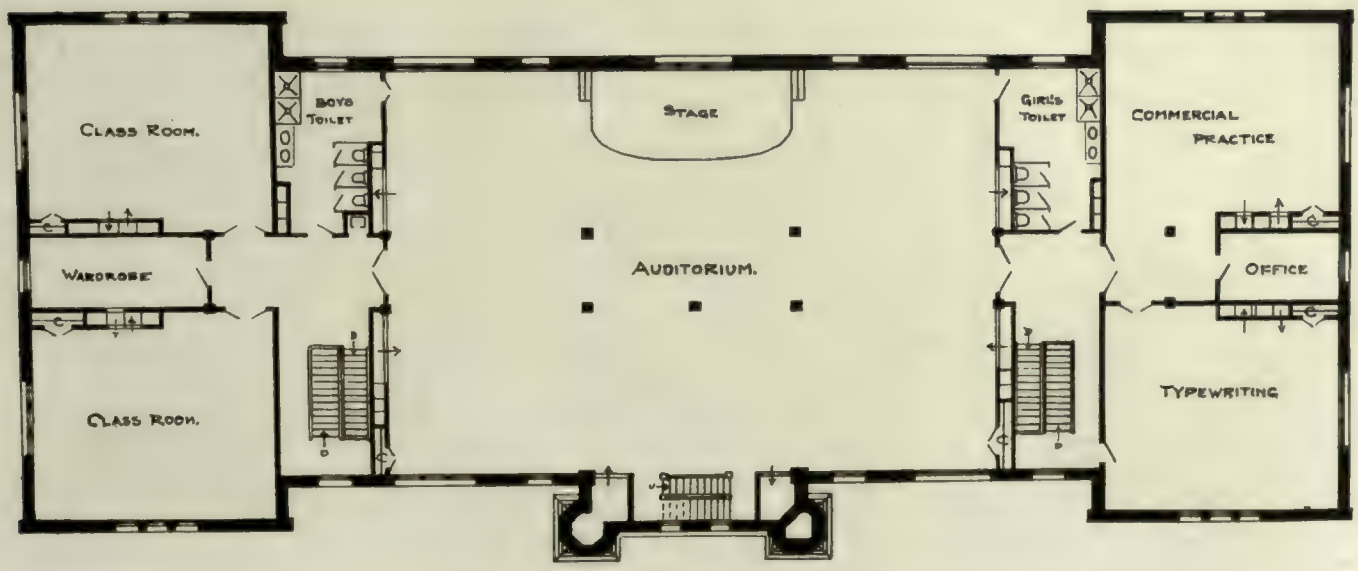
C. B. J. SNYDER
ARCHITECT



FIRST FLOOR



SECOND FLOOR

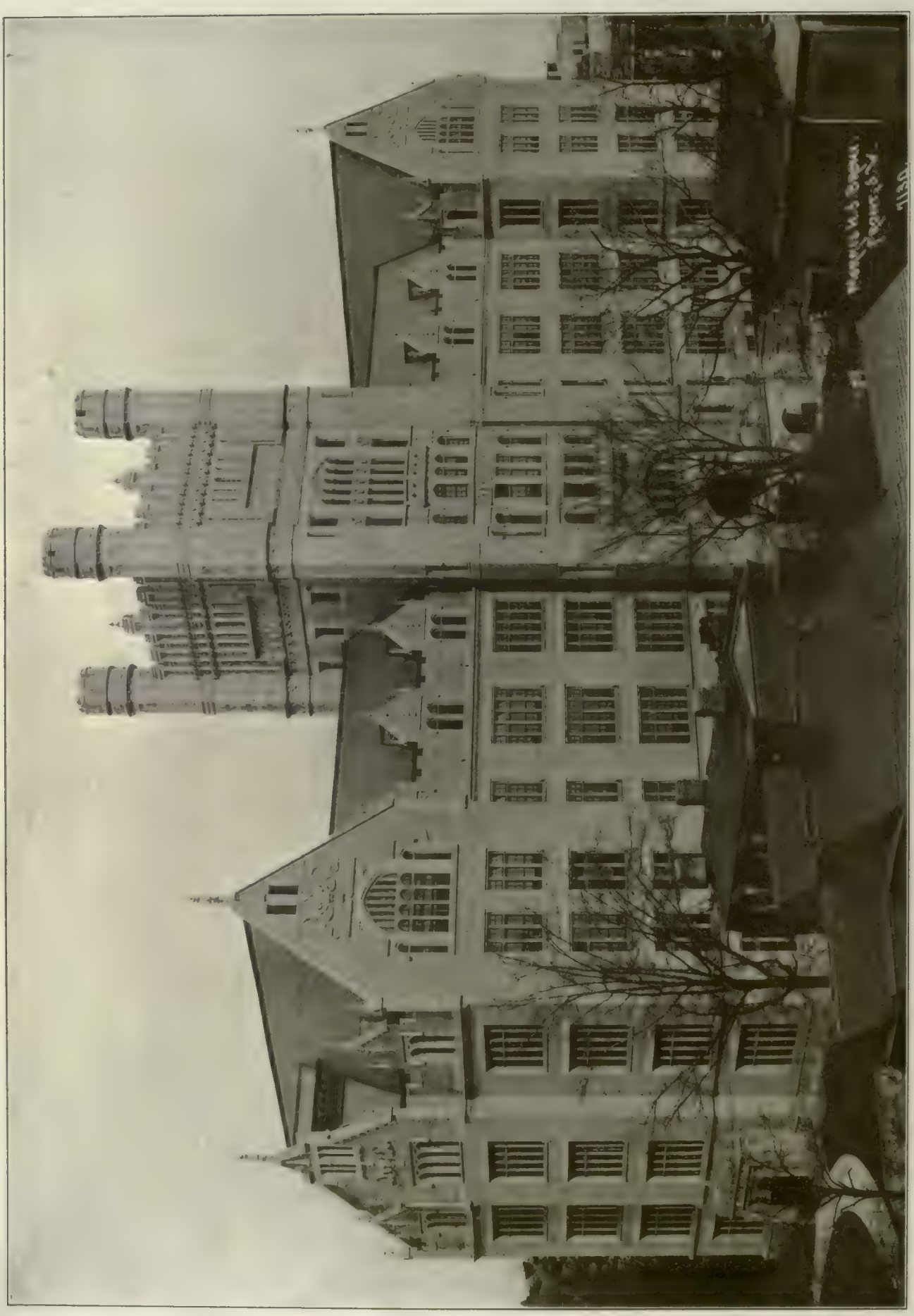


FOURTH FLOOR

FLOOR PLANS: CURTIS HIGH-SCHOOL, RICHMOND

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

C. B. J. SNYDER
ARCHITECT



PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

THE MORRIS HIGH SCHOOL, 165TH STREET AND EAST BOSTON ROAD

C. B. J. SNYDER
ARCHITECT

ASSEMBLY ROOM

ASSEMBLY ROOM

THE MORRIS HIGH SCHOOL, 165TH STREET AND EAST BOSTON ROAD

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

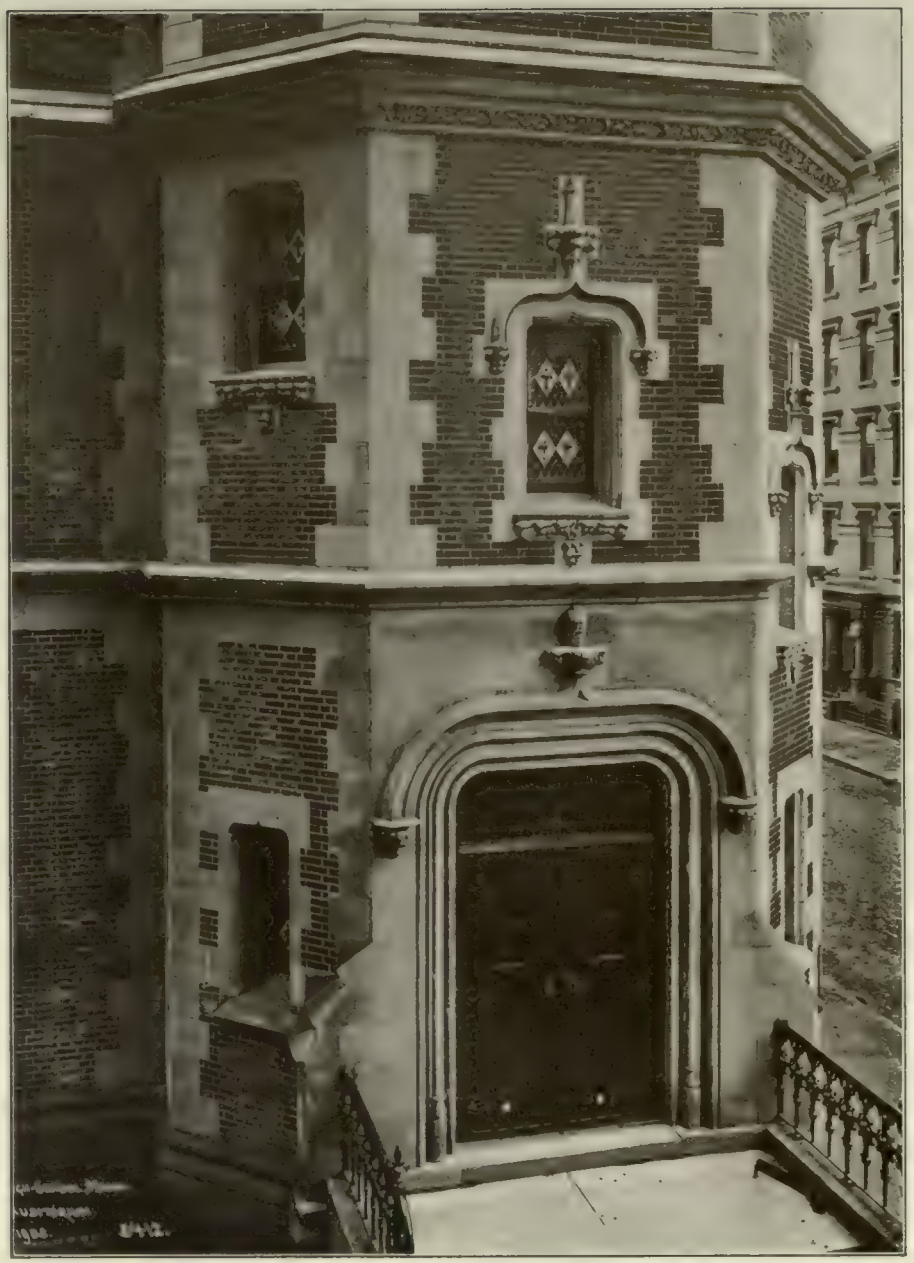
C. B. J. SNYDER
ARCHITECT

TOWER AND MAIN ENTRANCE: WADLEIGH HIGH SCHOOL
114TH STREET NEAR SEVENTH AVENUE

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

C. B. J. SNYDER
ARCHITECT

ENTRANCE ON 115TH STREET TO ASSEMBLY ROOM



DETAIL: MAIN ENTRANCE

WADLEIGH HIGH SCHOOL, 114TH STREET, NEAR SEVENTH AVENUE

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

C. B. J. SNYDER
ARCHITECT

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

PUBLIC SCHOOL NO. 165, 109TH STREET, NEAR AMSTERDAM AVENUE

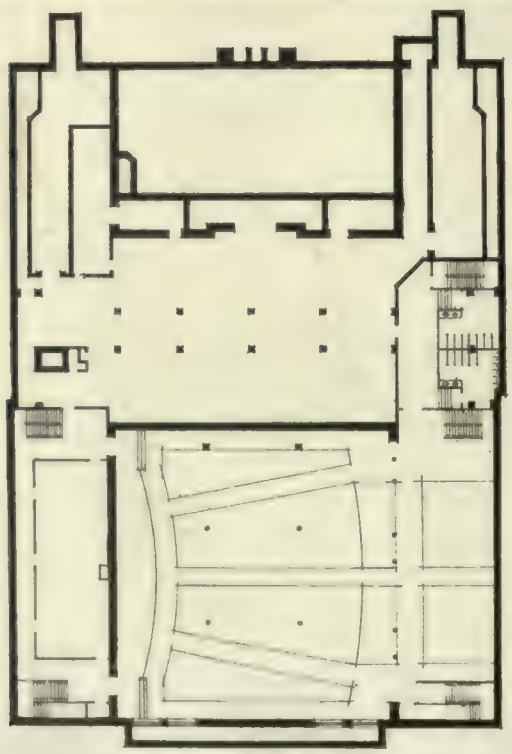
C. B. J. SNYDER
ARCHITECT

PUBLIC SCHOOL NO. 147, BROOKLYN: WEST ENTRANCE

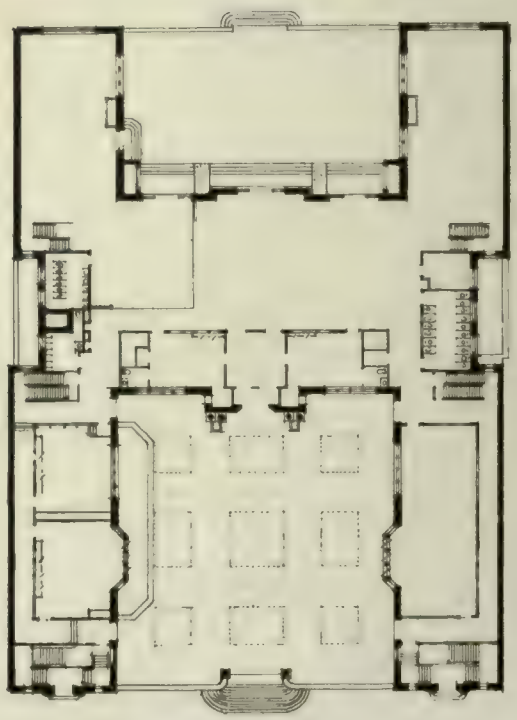
PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

PUBLIC SCHOOL NO. 37, BRONX: SOUTH GATE

C. B. J. SNYDER
ARCHITECT



BASEMENT FLOOR PLAN
PUBLIC SCHOOL 37 BRONX



FIRST FLOOR PLAN
PUBLIC SCHOOL 37 BRONX

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

PUBLIC SCHOOL 37, BRONX

MR. C. B. J. SNYDER
ARCHITECT

PUBLIC SCHOOL NO. 153, BRONX

ENTRANCE: PUBLIC SCHOOL NO. 153, BRONX

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

C. B. J. SNYDER
ARCHITECT

PUBLIC SCHOOL NO. 34, RICHMOND

MAIN ENTRANCE: PUBLIC SCHOOL NO. 34, RICHMOND

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

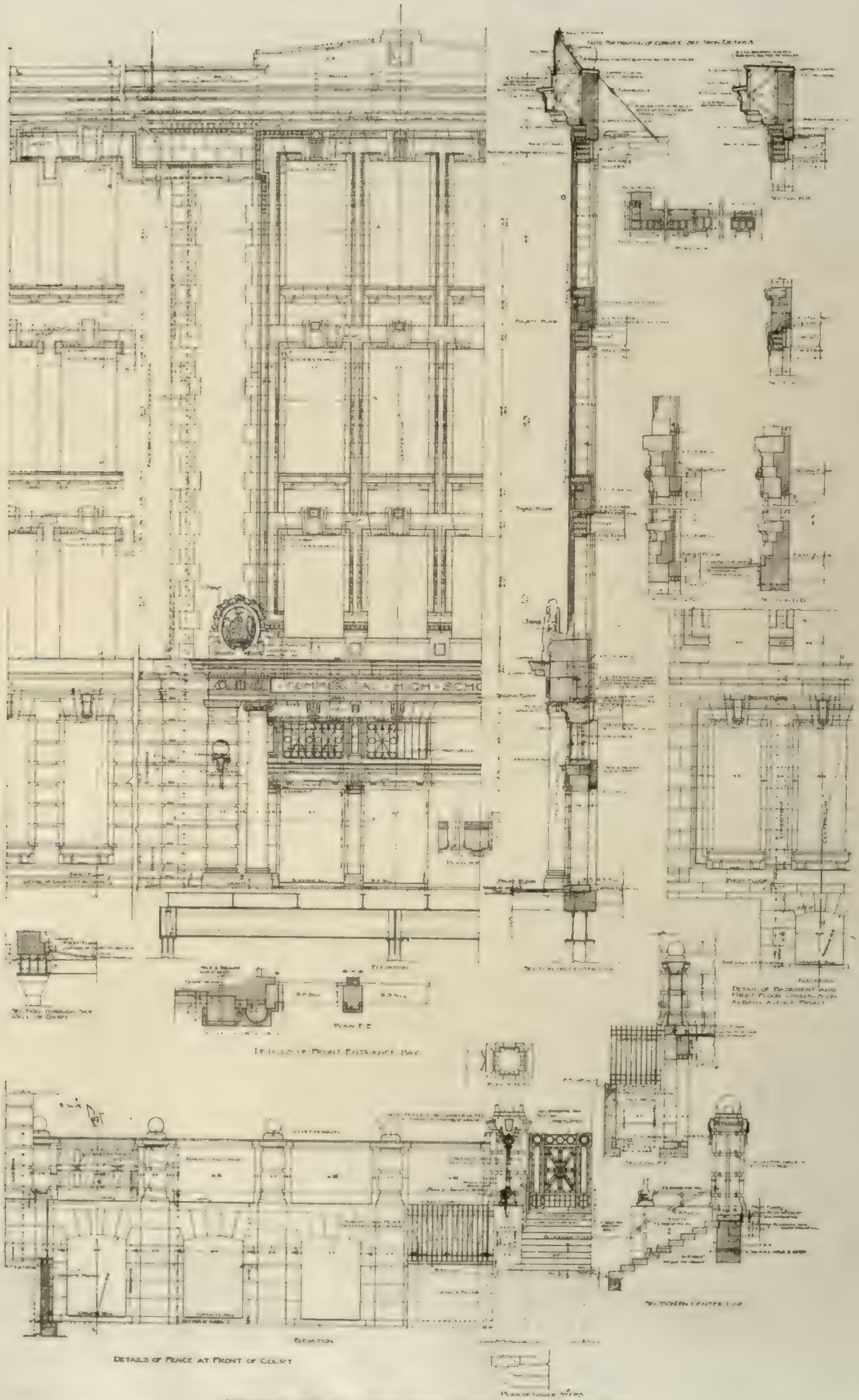
C. B. J. SNYDER
ARCHITECT

COMMERCIAL HIGH SCHOOL, BROOKLYN

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

EAST GATE: COMMERCIAL HIGH SCHOOL, BROOKLYN

C. B. J. SNYDER
ARCHITECT



MASONRY DETAILS: COMMERCIAL HIGH SCHOOL, BROOKLYN

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

C. B. J. SNYDER
ARCHITECT

PUBLIC SCHOOL NO. 137, BROOKLYN

PUBLIC SCHOOL NO. 147, BROOKLYN

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

C. B. J. SNYDER
ARCHITECT

PUBLIC SCHOOL NO. 3, HUDSON AND GROVE STREETS

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

C. B. J. SNYDER
ARCHITECT

MAIN ENTRANCE: PUBLIC SCHOOL NO. 165

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

MAIN ENTRANCE: PUBLIC SCHOOL NO. 175

C. B. J. SNYDER
ARCHITECT

GENERAL VIEW

DETAIL: MAIN ENTRANCE PUBLIC SCHOOL NO. 31 (OLD 167), 144TH STREET AND MOTT AVENUE

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

C. B. J. SNYDER
ARCHITECT

PUBLIC SCHOOL 38

DEWITT CLINTON HIGH SCHOOL, TENTH AVENUE, FIFTY-EIGHTH AND FIFTY-NINTH STREETS, NEW YORK

PUBLIC SCHOOL BUILDINGS
NEW YORK, N. Y.

C. B. J. SNYDER
ARCHITECT

PENN'S VALLEY SCHOOL

TREVOSE, PA.

CHELTENHAM HIGH SCHOOL

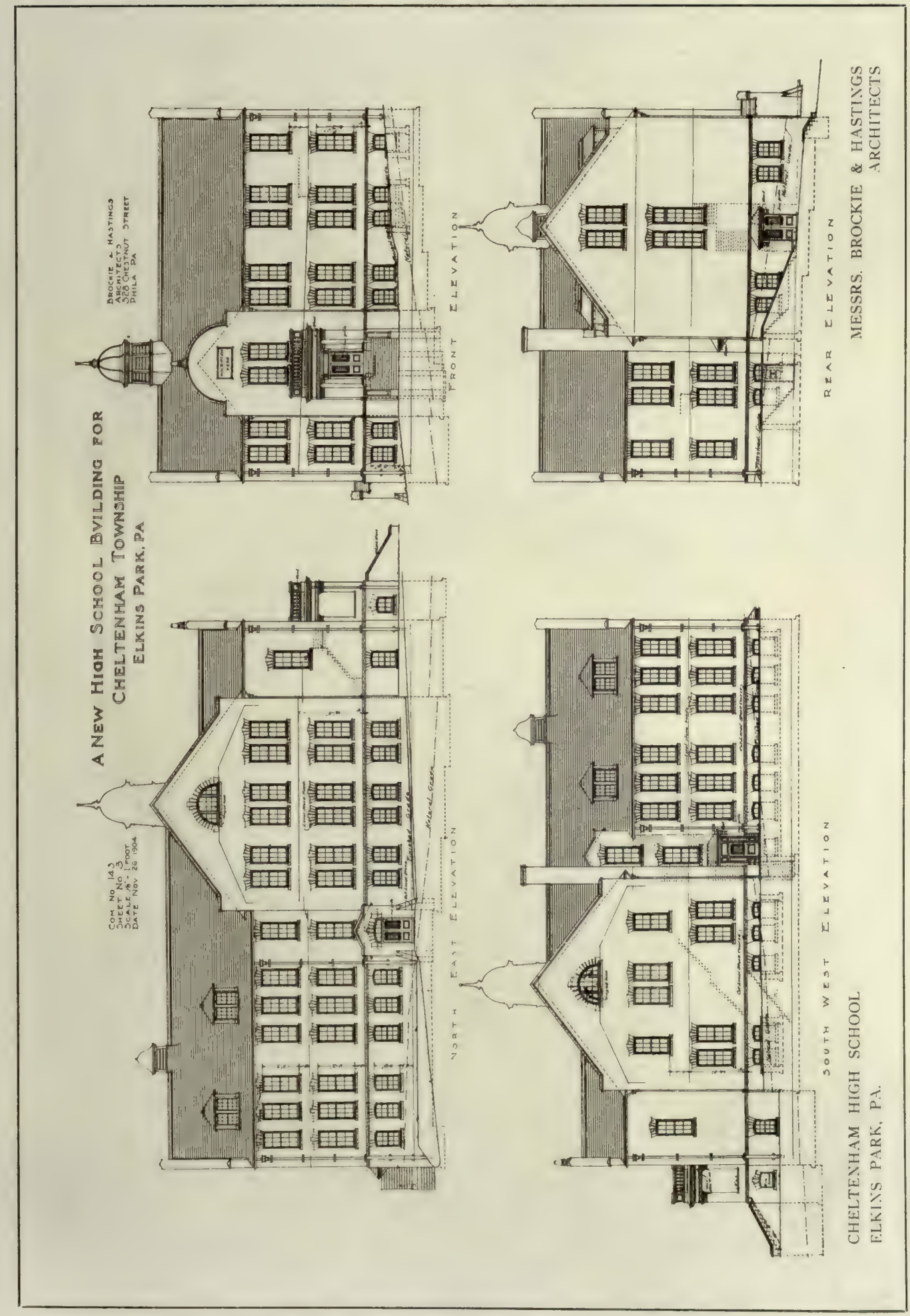
FRONT VIEW

ELKINS PARK, PA.

CHELTENHAM HIGH SCHOOL.
ELKINS PARK, PA.

REAR VIEW

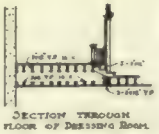
MESSRS. BROCKIE & HASTINGS
ARCHITECTS


A NEW HIGH SCHOOL BUILDING FOR
CHELTENHAM TOWNSHIP
ELKINS PARK, PA
BROCKIE & HASTINGS
ARCHITECTS
328 CHESTNUT STREET
PHILA PA
COM NO 143
SHEET NO 3
SCALE 1/8" = 1 FOOT
DATE NOV 26 1904
FRONT ELEVATION
REAR ELEVATION
NORTH EAST ELEVATION
SOUTH WEST ELEVATION
MESSRS. BROCKIE & HASTINGS
ARCHITECTS
CHELTENHAM HIGH SCHOOL
ELKINS PARK, PA.

A NEW HIGH SCHOOL BUILDING FOR CHELTENHAM TOWNSHIP
ELKINS PARK, PA.

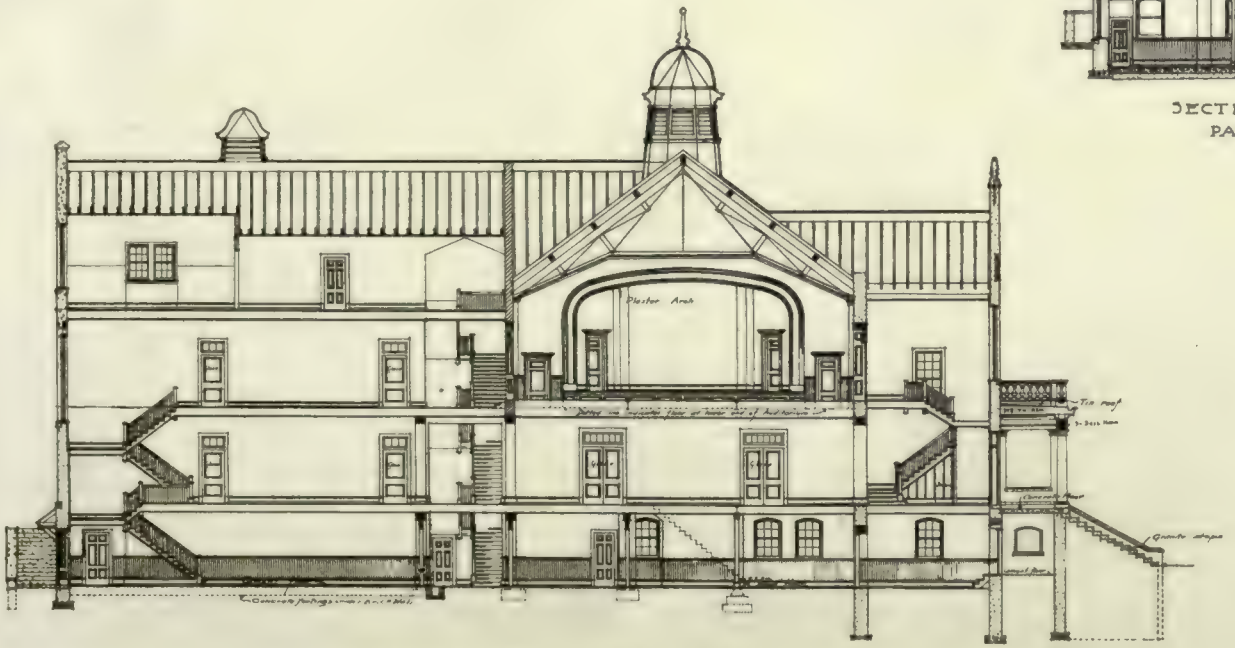
COM Nº 143
SHEET Nº 4
SCALE ⅛" = 1 FOOT
DATE - NOV 26, 1904

BROCKIE & HASTINGS
ARCHITECTS
328 CHESTNUT STREET
PHILADELPHIA

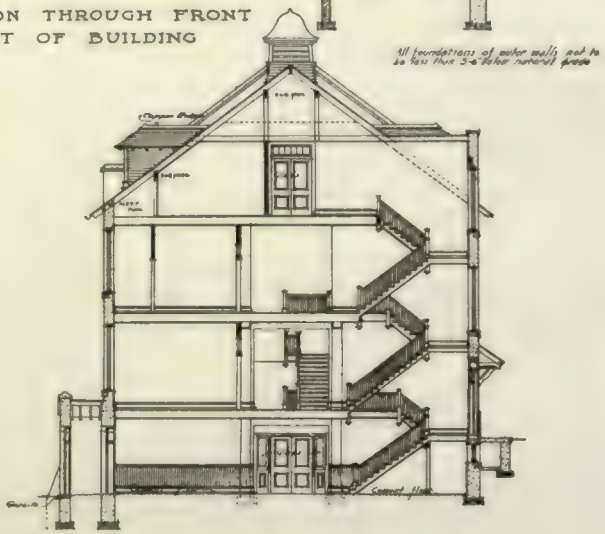


SECTION THROUGH
FLOOR OF DRESSING ROOM

SECTION THROUGH FRONT
PART OF BUILDING



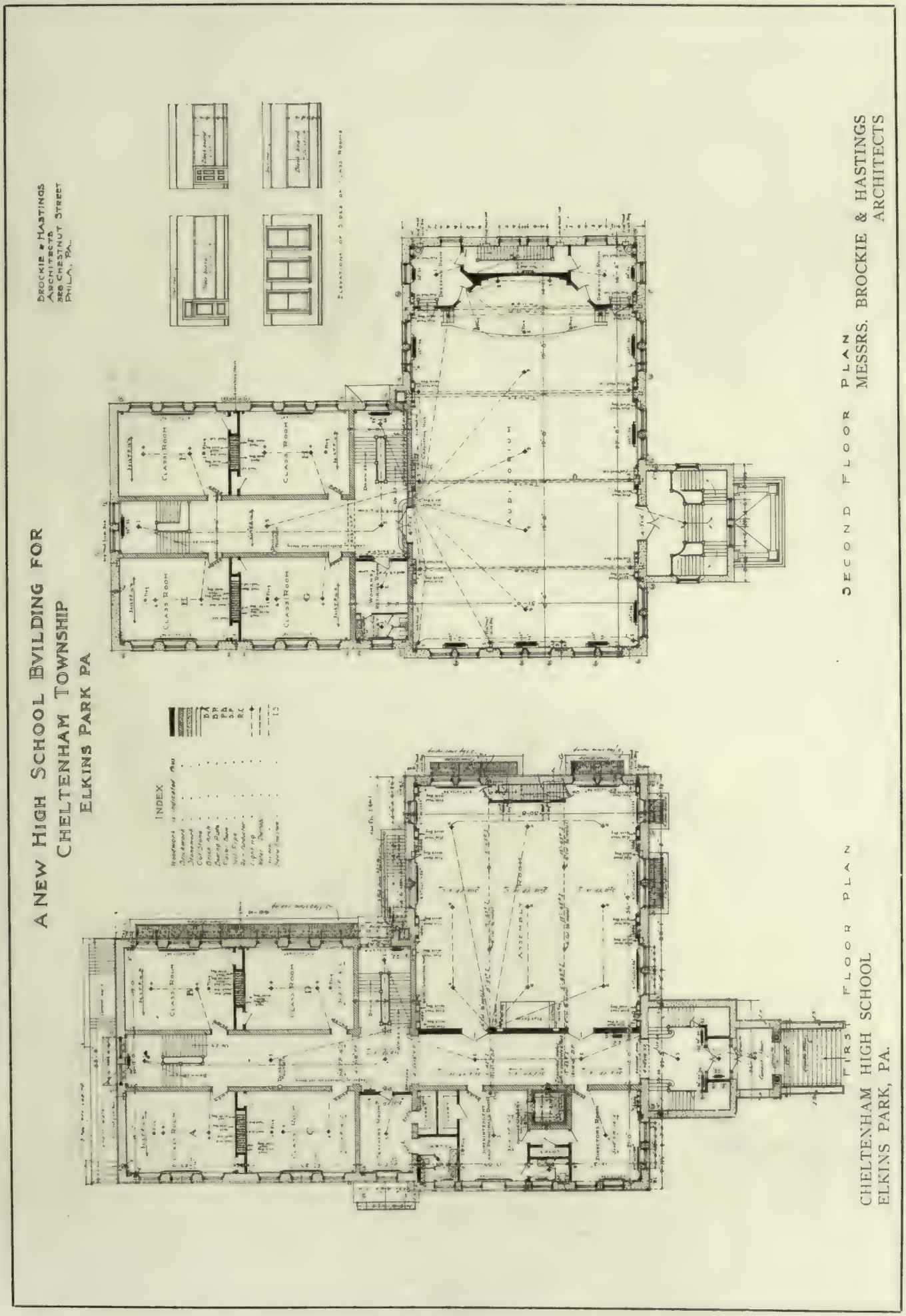
LONGITUDINAL SECTION



TRANSVERSE SECTION

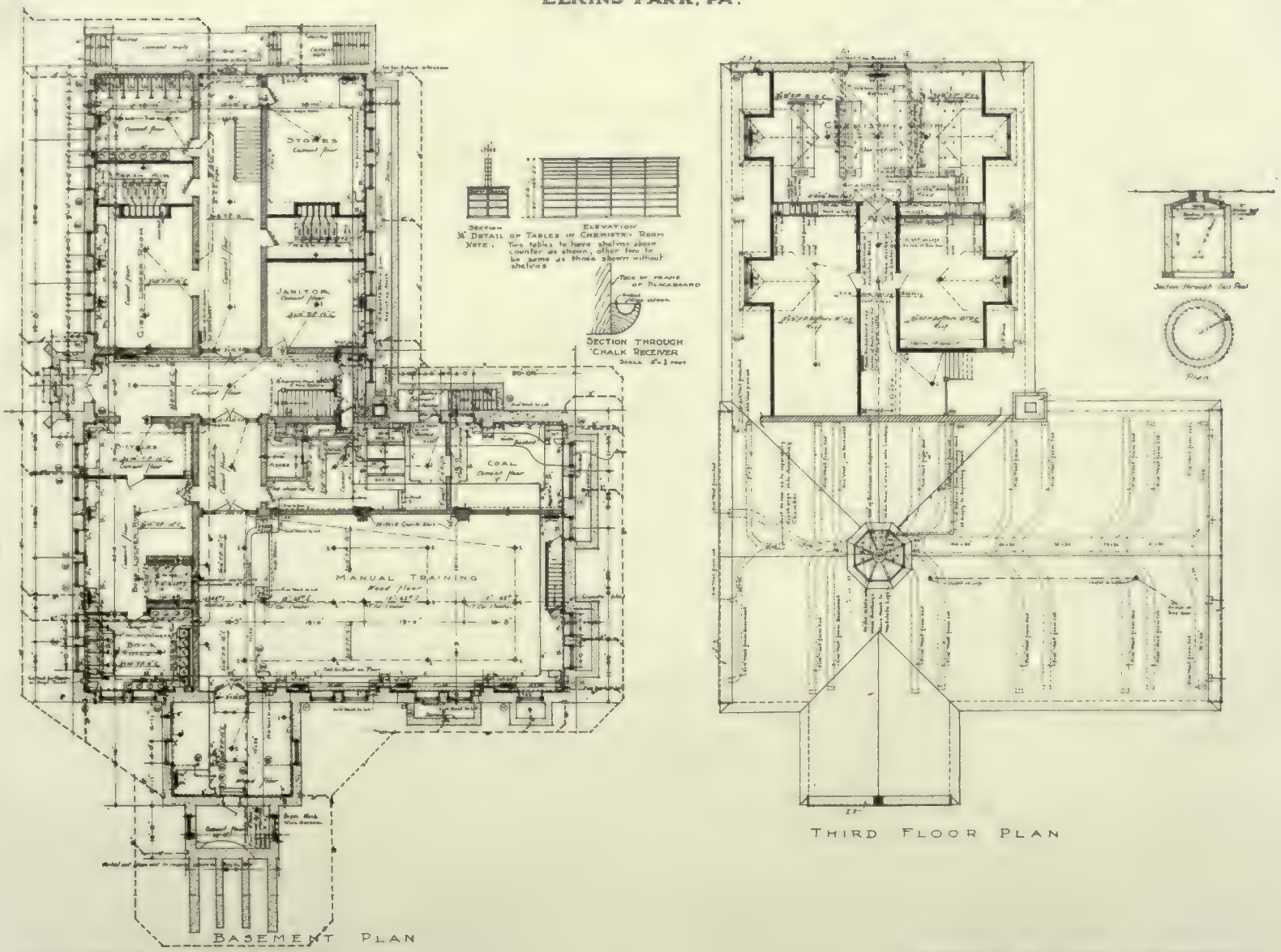
CHELTENHAM HIGH SCHOOL
ELKINS PARK, PA.

MESSRS. BROCKIE & HASTINGS
ARCHITECTS


A NEW HIGH SCHOOL BVILDING FOR
CHELTENHAM TOWNSHIP
ELKINS PARK PA
BROCKIE & HASTINGS
ARCHITECTS
328 CHESTNUT STREET
PHILA. PA.
INDEX
SECOND FLOOR PLAN
MESSRS. BROCKIE & HASTINGS
ARCHITECTS
FIRST FLOOR PLAN
CHELTENHAM HIGH SCHOOL
ELKINS PARK, PA.

A NEW HIGH SCHOOL BVILDING FOR CHELTENHAM TOWNSHIP ELKINS PARK, PA.

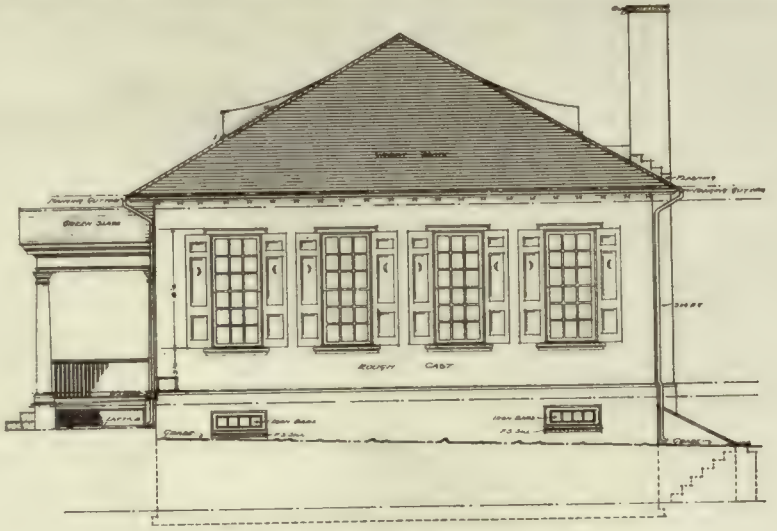
BROCKIE & HASTINGS
ARCHITECTS
328 CHESTNUT ST.
PHILADELPHIA PA



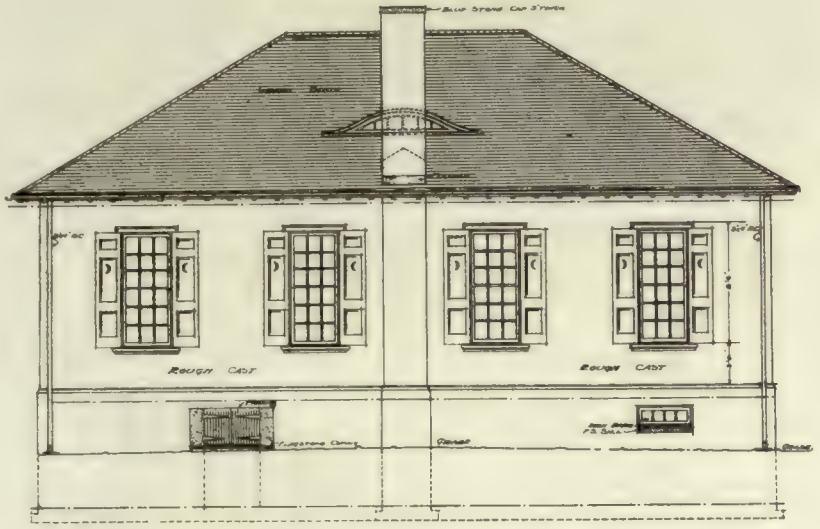
CHELTENHAM HIGH SCHOOL
ELKINS PARK, PA.

MESSRS. BROCKIE & HASTINGS
ARCHITECTS

FRONT ELEVATION



SIDE ELEVATION
OTHER SIDE SAME REVERSED

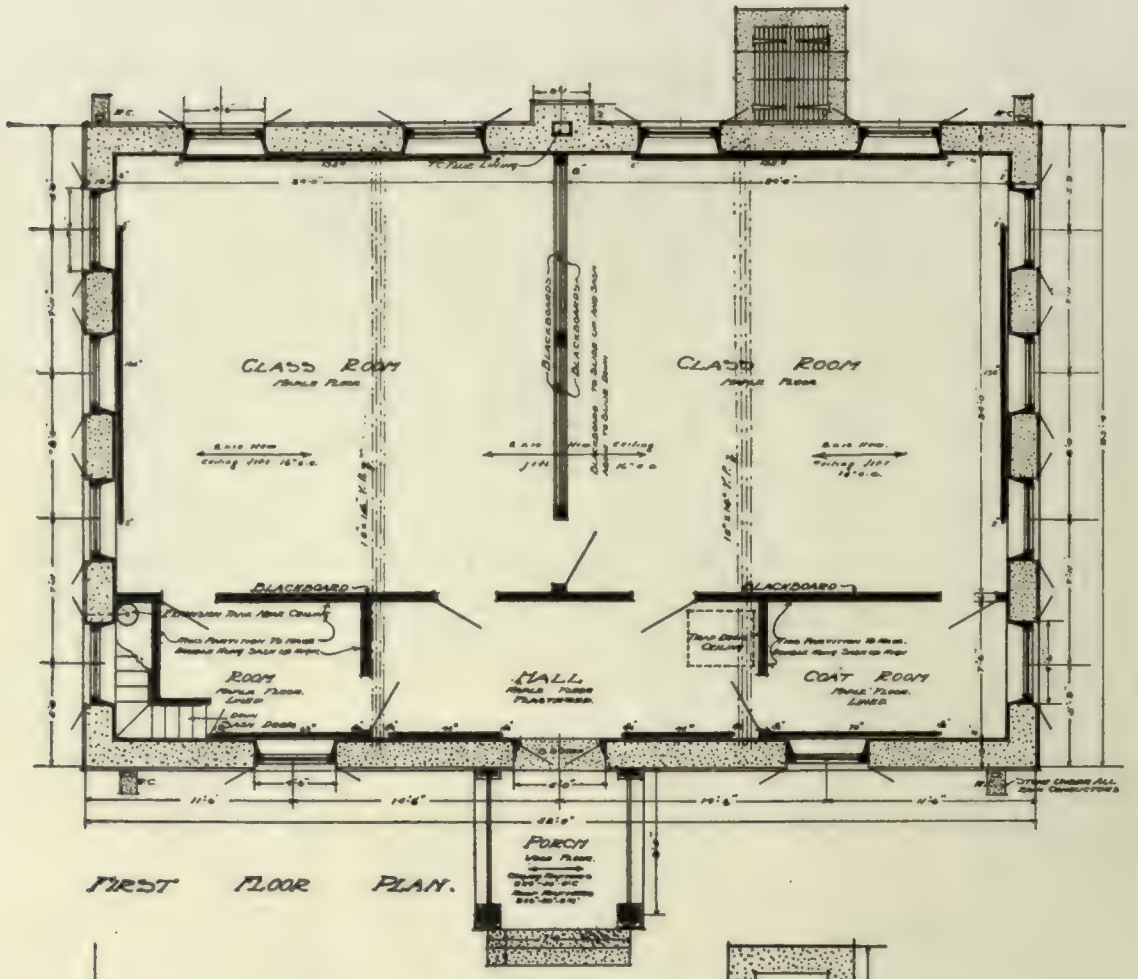


REAR ELEVATION PENN'S VALLEY SCHOOL HOUSE.
DYBERRY & BENSALEM TURNPIKE
NEAR
TREVOSE, BUCKS CO., PA

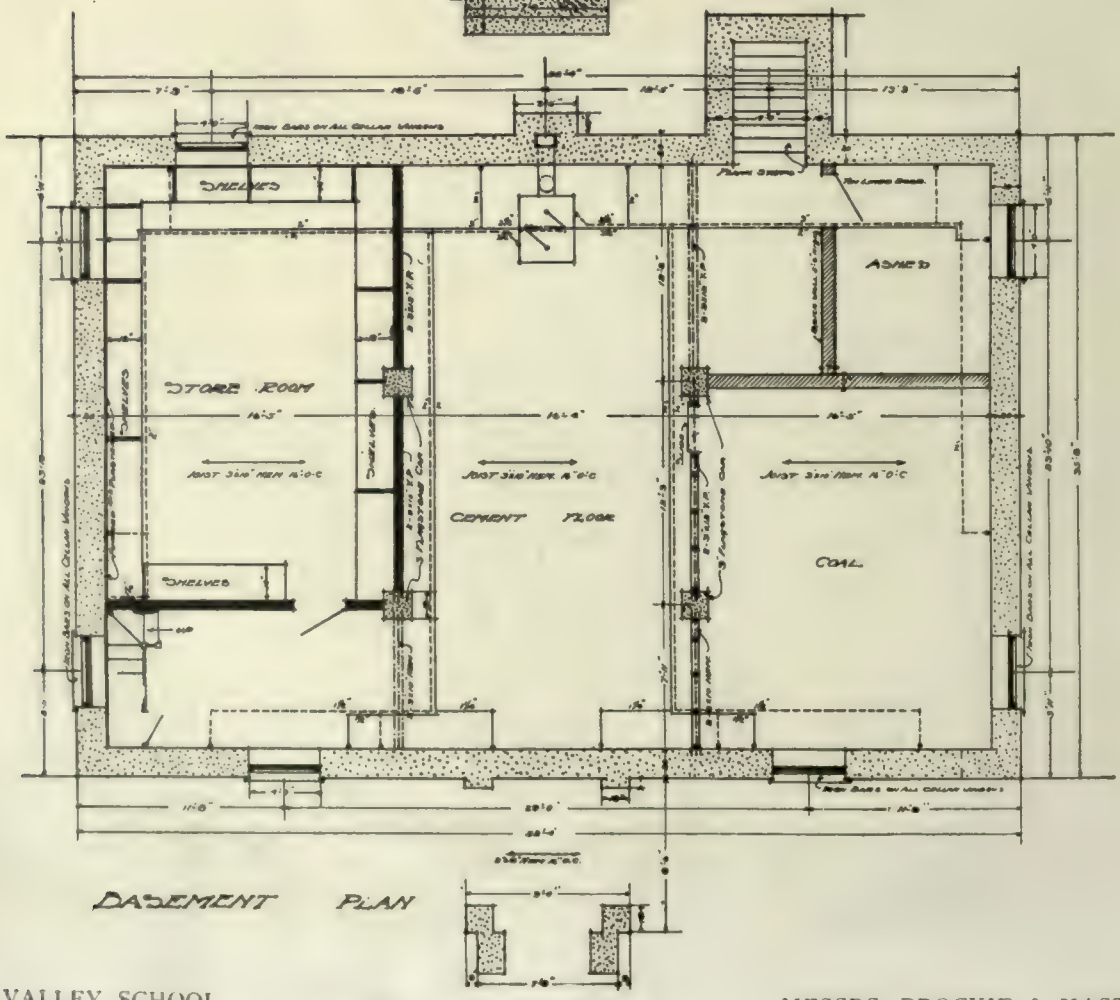
SECTION

PENN'S VALLEY SCHOOL
TREVOSE, PA.

MESSRS. BROCKIE & HASTINGS
ARCHITECTS



FIRST FLOOR PLAN.



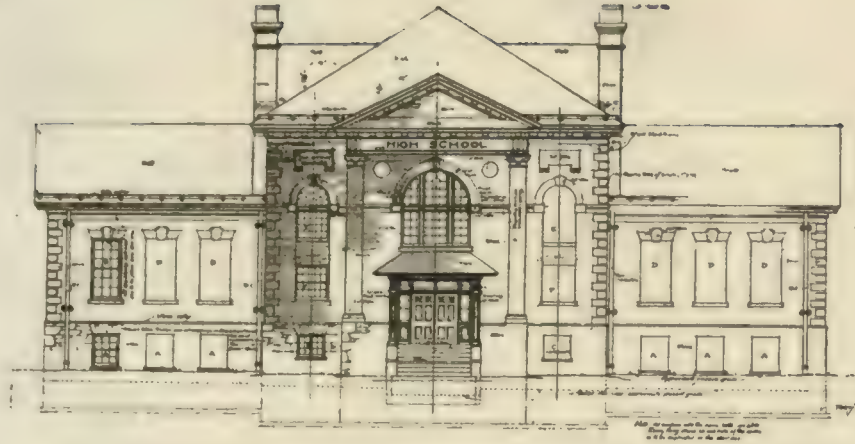
BASEMENT PLAN

PENN'S VALLEY SCHOOL
TREVOSE, PA.

MESSRS. BROCKIE & HASTINGS
ARCHITECTS

NEW HIGH SCHOOL AT
BERWYN, PA.

MR. D. KNICKERBACKER BOYD
ARCHITECT

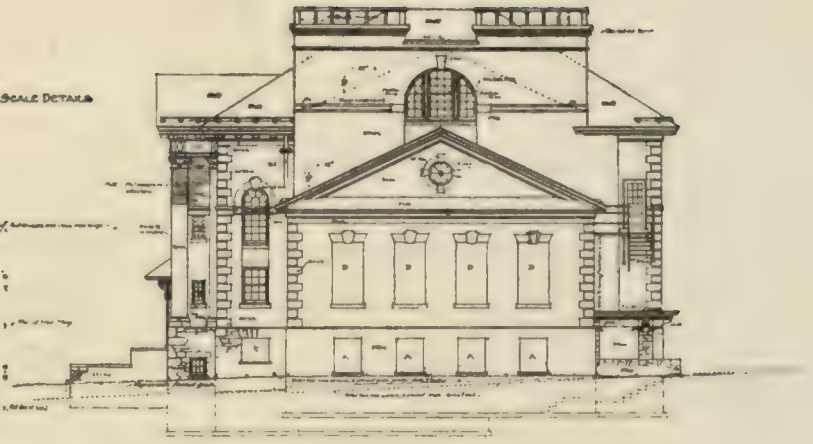


FRONT ELEVATION

Scale ⅛" = 1'-0"

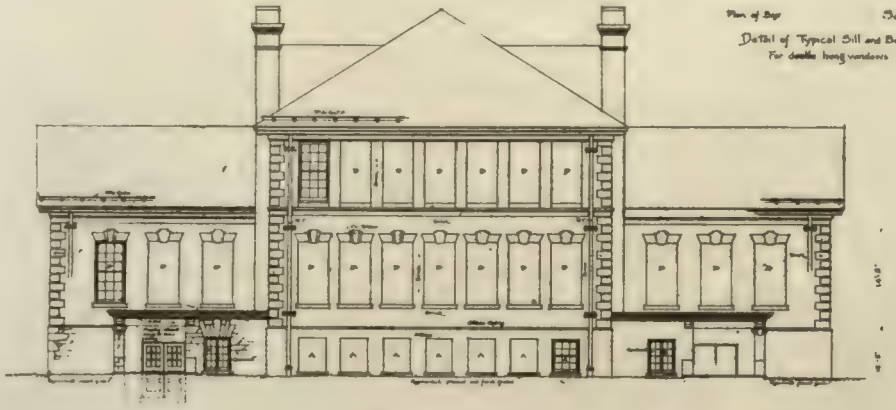
THE NEW HIGH SCHOOL BUILDING.
AT BERWYN, CHESTER CO., PA.
FOR THE
TOWNSHIPS OF EAST TOWN AND TREDYFFRIN.

¼ SCALE DETAILS



SIDE ELEVATION

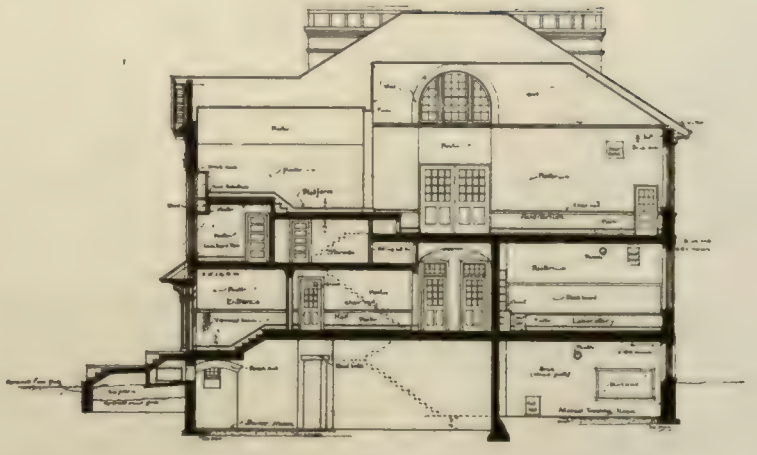
D. Knickerbacker Boyd, Architect
1611 Harrison Building, Phila. Pa.



Plan of Bay Section of Sill

Detail of Typical Sill and Bay
For double hung windows

REAR ELEVATION



CROSS SECTION.

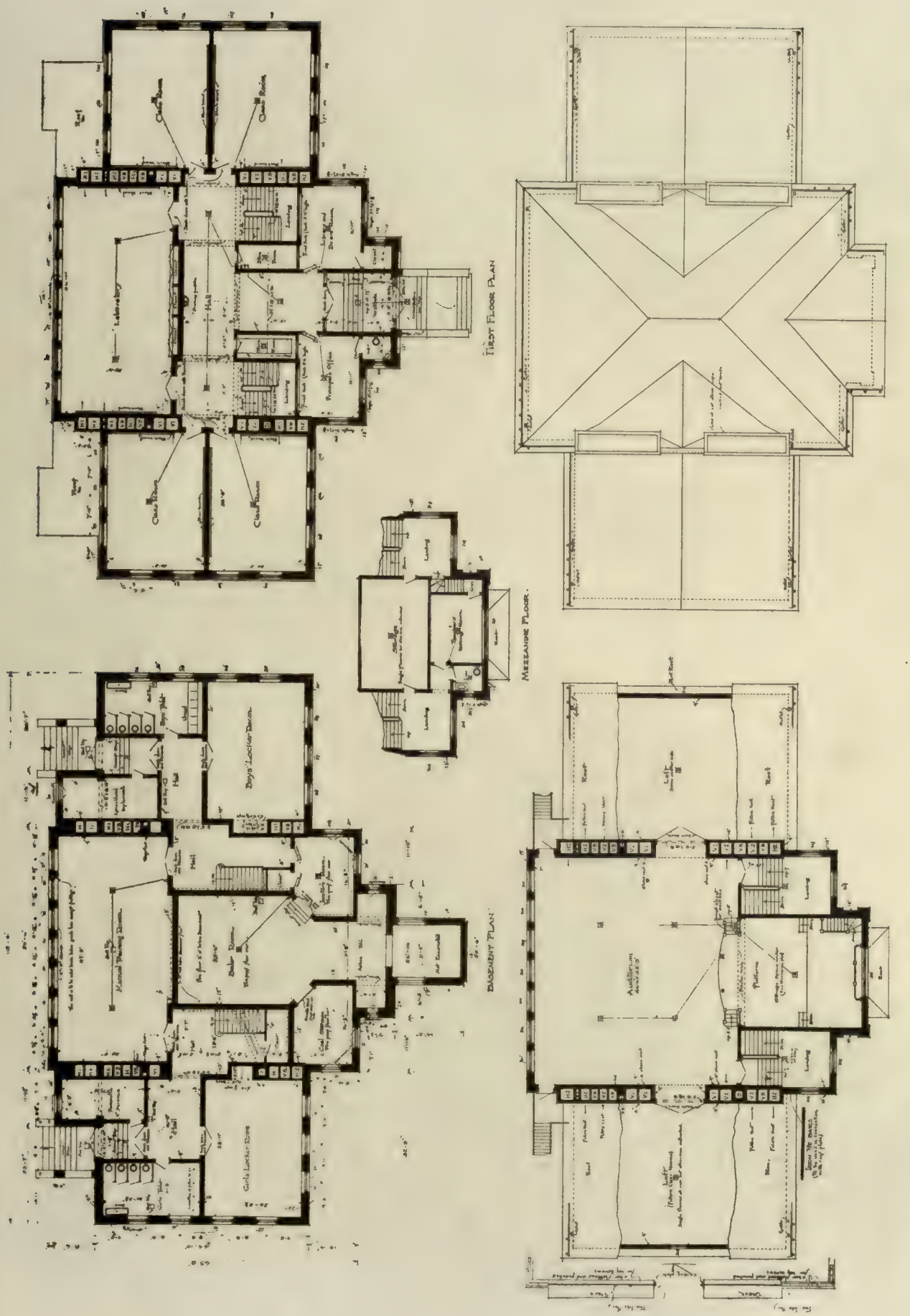
THE NEW HIGH SCHOOL BUILDING.
AT BERWYN, CHESTER CO., PA.
FOR THE
TOWNSHIPS OF EAST TOWN AND TREDYFFRIN.

Scale ⅛" = 1'-0"

D. Knickerbacker Boyd, Architect
1611 Harrison Building Phila. Pa.

NEW HIGH SCHOOL AT
BERWYN, PA

MR. D. KNICKERBACKER BOYD
ARCHITECT

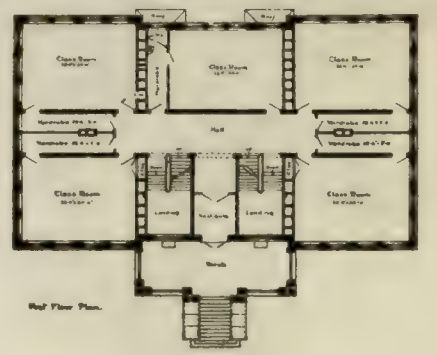


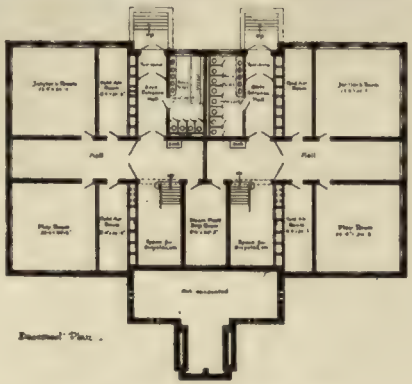
NEW HIGH SCHOOL AT BERWYN, PA.

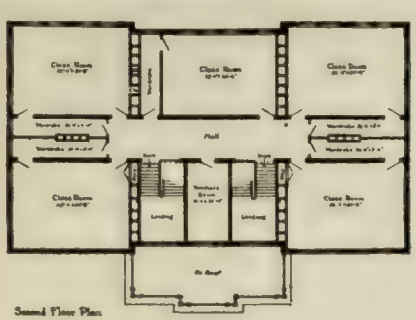
MR. D. KNICKERBACKER BOYD
ARCHITECT

GRAMMAR AND PRIMARY SCHOOL
WAYNE, PA.

MR. D. KNICKERBACKER BOYD
ARCHITECT







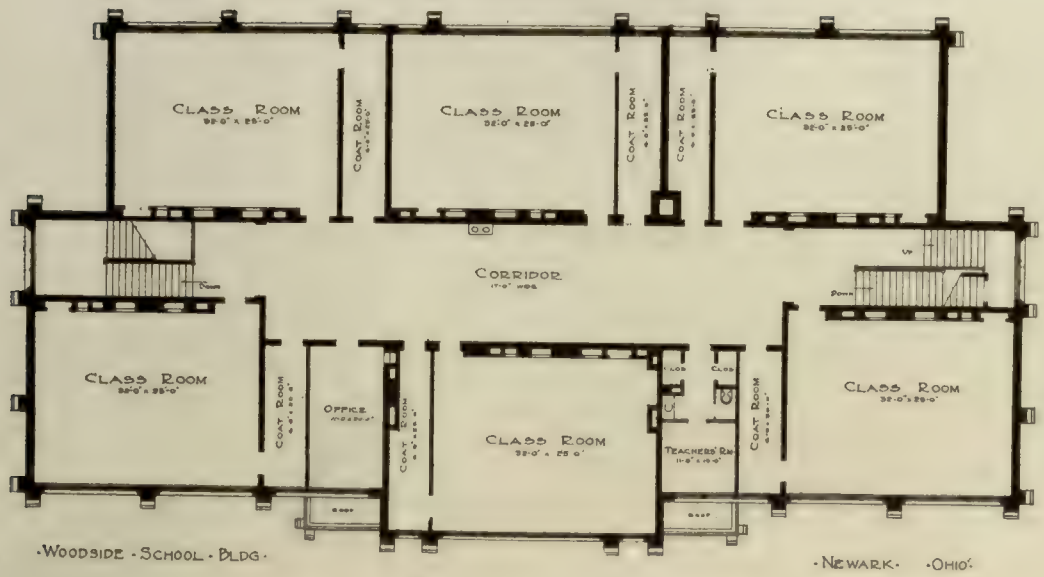
GRAMMAR AND PRIMARY SCHOOL
WAYNE, PA.

REAR VIEW AND FLOOR PLANS

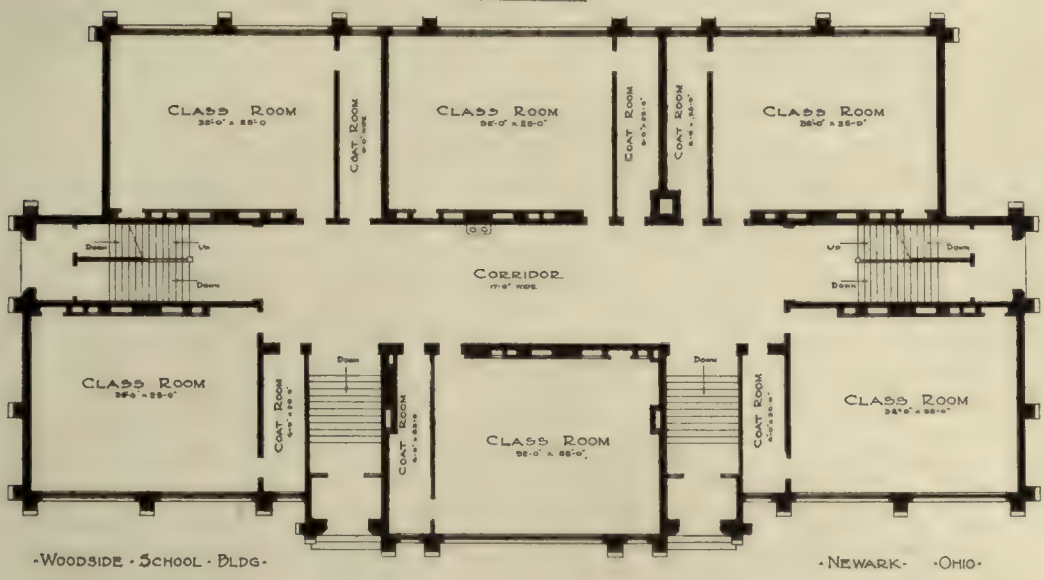
MR. D. KNICKERBACKER BOYD
ARCHITECT

WOODSIDE SCHOOL
NEWARK, OHIO

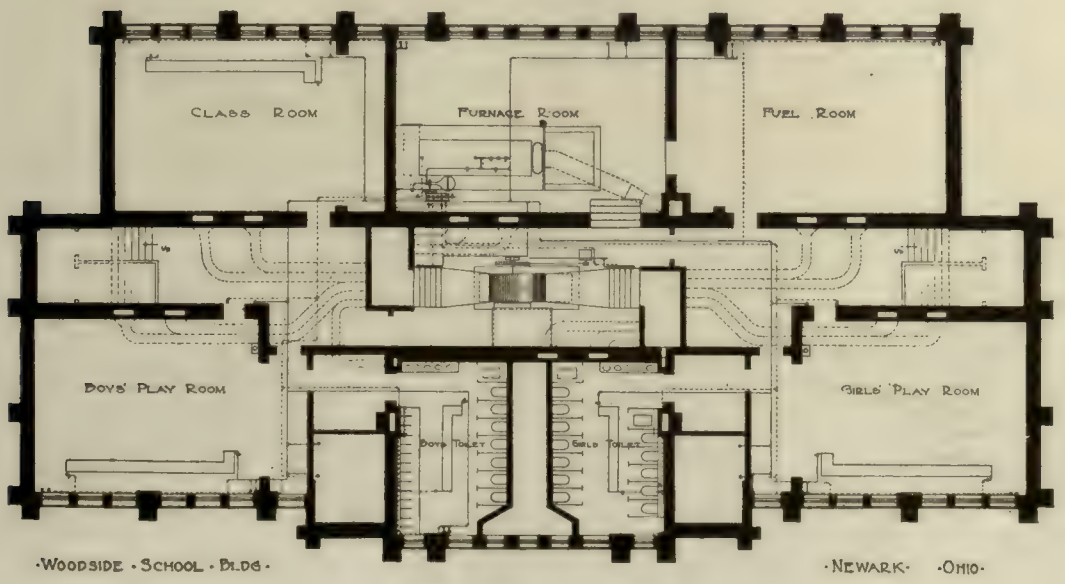
WILBUR T. MILLS
ARCHITECT



SECOND FLOOR PLAN



FIRST FLOOR PLAN



BASEMENT FLOOR PLAN

WOODSIDE SCHOOL
NEWARK, OHIO

WILBUR T. MILLS
ARCHITECT

HIGH SCHOOL
BATTLE CREEK, MICH.

WILBUR T. MILLS
ARCHITECT

WILBUR T. MILLS
ARCHITECT
HIGH SCHOOL
BATTLE CREEK, MICH.
SECOND FLOOR PLAN
SUB-BASEMENT FLOOR PLAN
BASEMENT FLOOR PLAN
CORRIDOR
GYMNASIUM
HEATING & VENTILATING SPACE
STORE ROOM
SCALE

FOUR MASSACHUSETTS SCHOOL HOUSES

KILHAM & HOPKINS, ARCHITECTS

The four school buildings illustrated in the following pages, the Haverhill High School, the Vose School in Milton and the Williams and Shurtleff Schools in Chelsea, were all completed during the years 1909 and 1910 and possess certain constructional features in common. The exterior of the Haverhill High School is of gray pressed brick and white terra cotta. All the others have exteriors of red water struck brick laid Flemish bond and white or gray terra cotta trimmings with brick heat and vent ducts and practically all brick interior walls. The boiler houses and considerable portions of the first floors are of reinforced concrete slabs on steel beams. All have floors and roof frame of steel girders and trusses and Georgia pine joists and all are wire lathed throughout. The staircases are all fireproof, made of iron and slate and enclosed in brick walls. The roofs are of asphalt composition, with copper flashing carried up parapet walls and under copings. The ventilation is by fans driven by steam engines, forcing the fresh air through concrete tunnels under the basement floor to the brick up-takes with automatic temperature control.

Interior finish is in oak. Individual ventilating closets and urinals with slate partitions are used in every case.

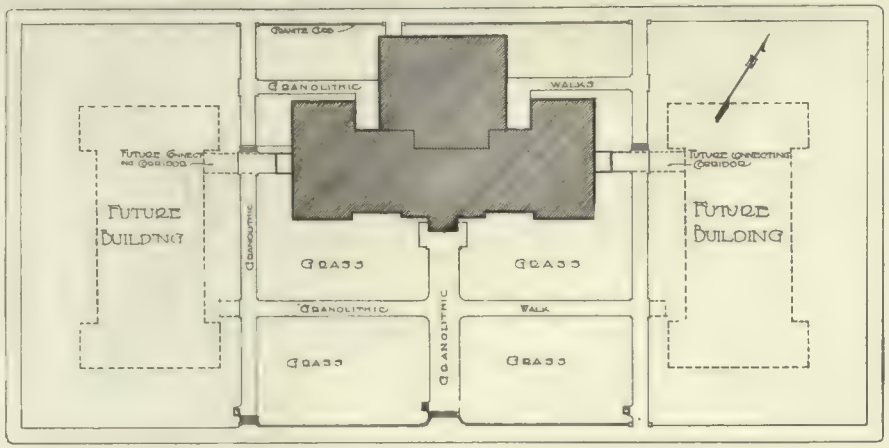
In these schools the intention was to secure not extreme cheapness but the most durable and attractive results. While not strictly "fireproof" in every sense of the word, the buildings are nearly so in fact and are fully as secure from fire danger.

The cost per cubic foot given includes in all cases general contract, plumbing, heating and ventilating and power plants, lighting fixtures and grading, seeding and curbing the grounds, granolithic outside walks and steps.

The "smoke doors" shown enclosing the stairways and the double entrances to each schoolroom are requirements of the local inspectors of the Massachusetts District Police and were obligatory where they were used. It should be noted, however, that the use of smoke doors is optional with the district inspector and while required by some is forbidden by others. The Milton School, for example, does not have them.

The buildings are lighted throughout with tungsten lamps, arranged for diffused illumination of the rooms.

All the buildings have direct basement entrances, thus reducing the amount of mud tracked into the buildings by pupils.



WILLIAMS SCHOOL
CHELSEA, MASS.

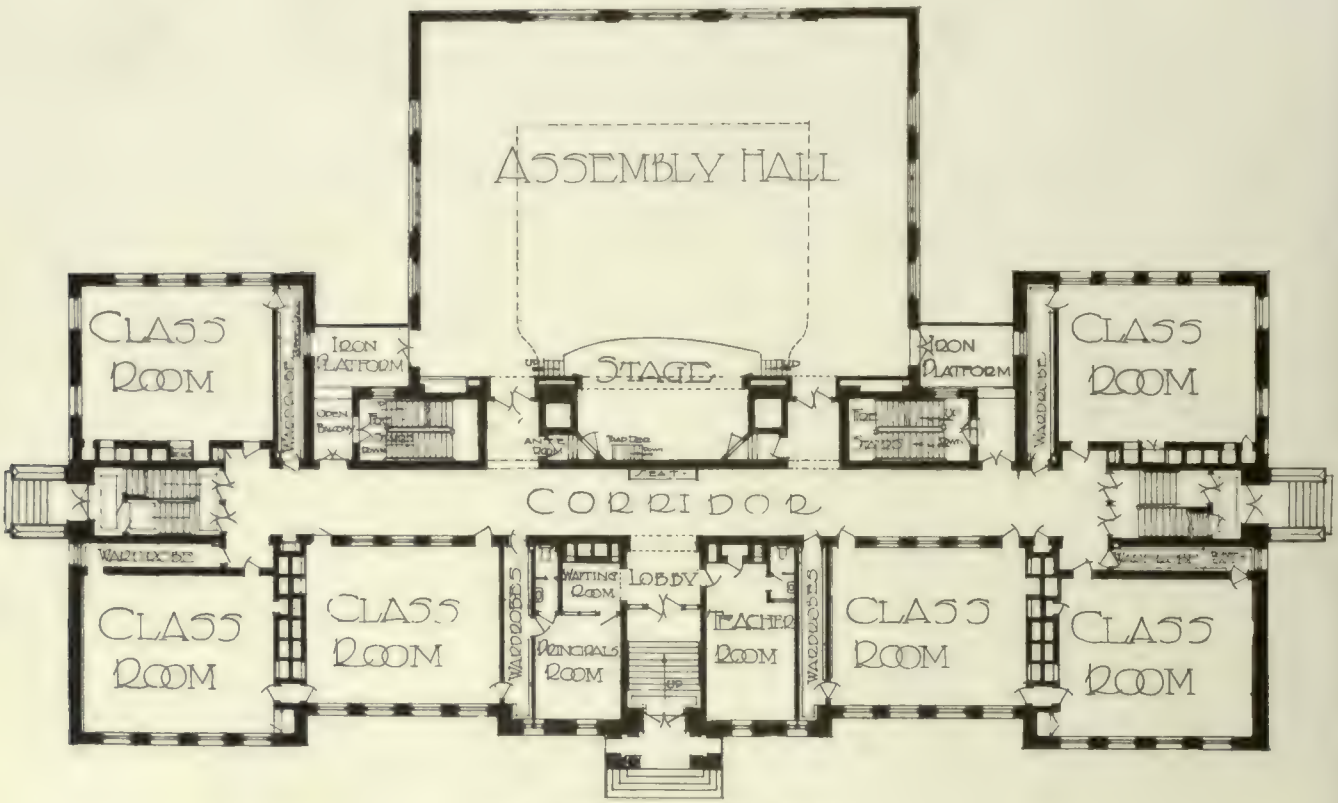
KILHAM & HOPKINS
ARCHITECTS

This building has been designed as the central structure of a future group of three, and contains the assembly hall and boiler plant for the entire group. The other buildings are to be a 16-room building on either side. The assembly hall is on the first floor and is arranged so that it may be readily used by the general public without entering the main building. The exterior treatment of red water-struck brick and gray terra cotta presents a very dignified and scholarly facade.

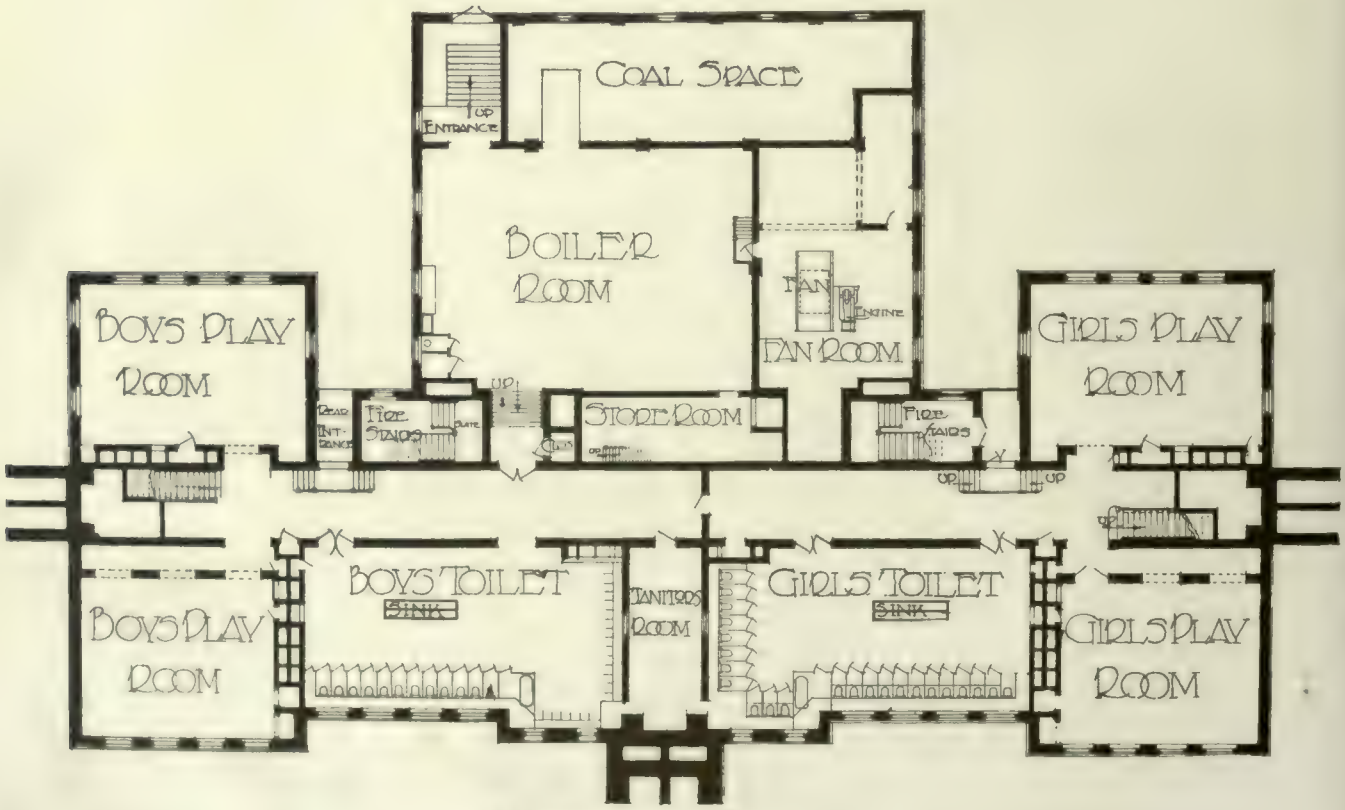
The floors throughout the building are of rift Georgia pine. The general trim is slashed oak. Slate blackboards and dadoes of burlap are found in all classrooms. The stair construction consists of iron everywhere, except the treads, which are of slate. In addition to the regular stairs there is a special type of fire escape stairs, which are enclosed in brick towers, included within the outside walls of the building and yet entirely isolated from the interior, which are so planned that no one can enter them without first passing out of doors upon an open balcony. This precaution was taken so that the towers would always be free from smoke in case of fire.

There are twenty classrooms, which accommodate fifty pupils each, making the total number of 1,000 scholars. There are also four fully-equipped basement rooms.

The cost of the entire building is $166,829, or approximately 16½ cents per cubic foot. The cost per pupil is therefore $166, which is high for the building already built but will be very moderate when the proportionate cost of the assembly hall is charged to the 1,600 additional pupils who will occupy the remaining buildings of the group.



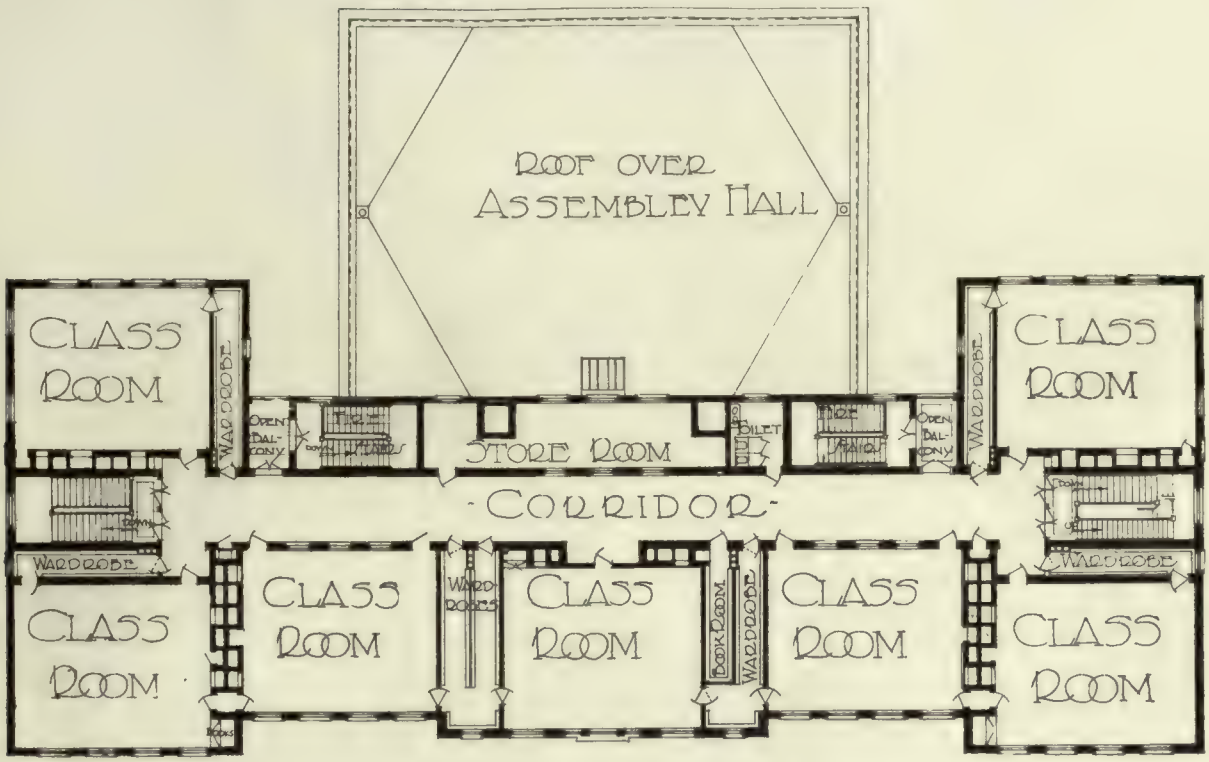
FIRST FLOOR PLAN



BASEMENT PLAN

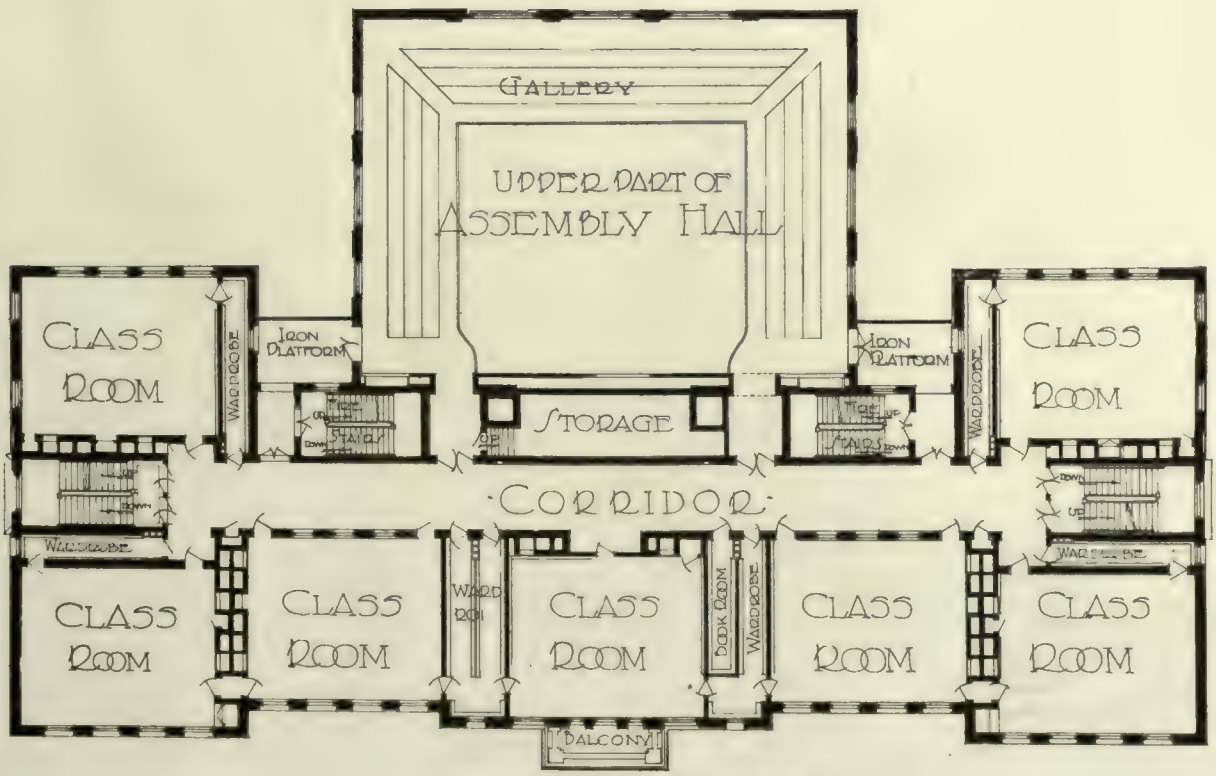
WILLIAMS SCHOOL
CHELSEA, MASS.

KILHAM & HOPKINS
ARCHITECTS



THIRD FLOOR PLAN

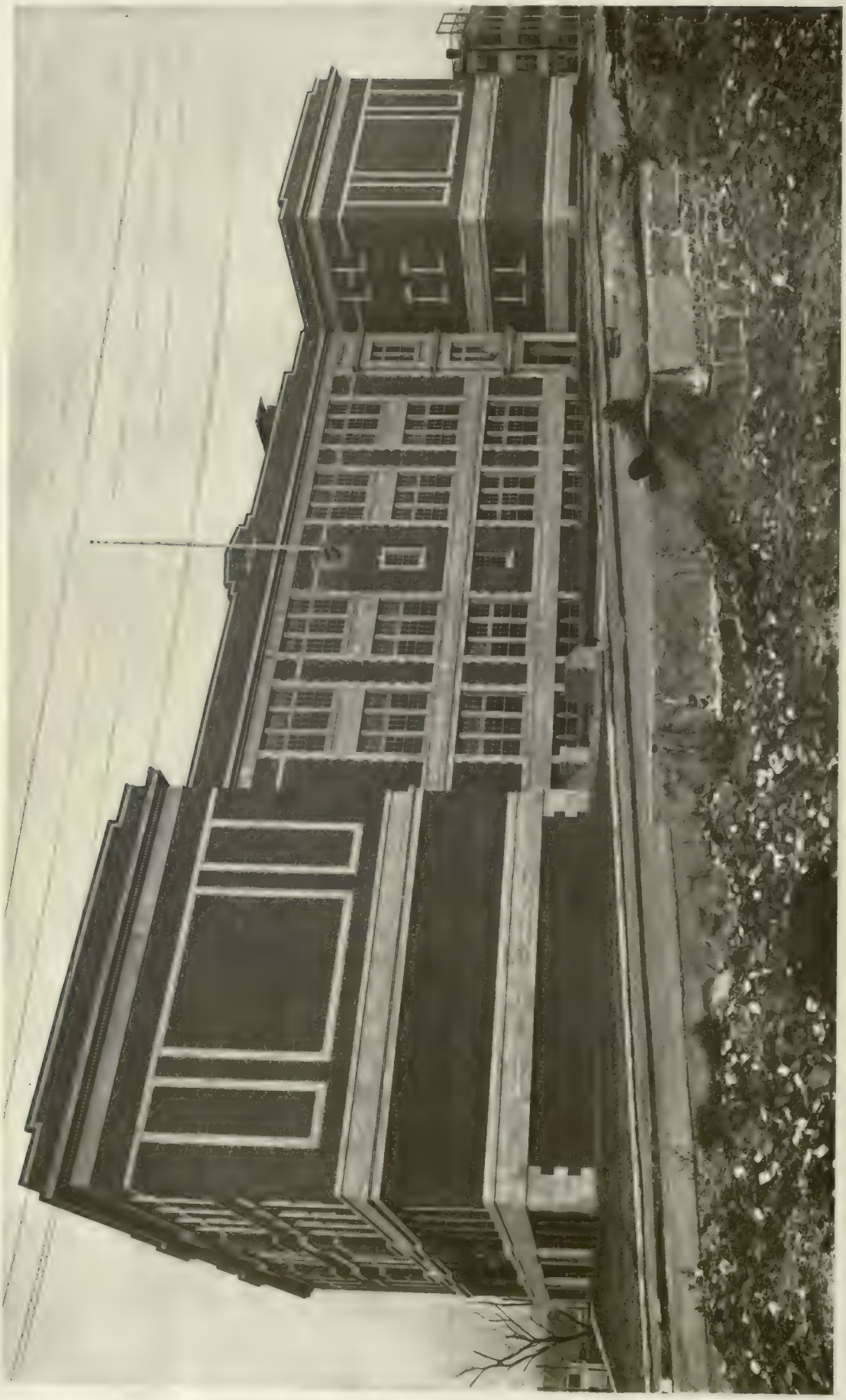
SCALE 1/8 IN = 1 FT.



SECOND FLOOR PLAN

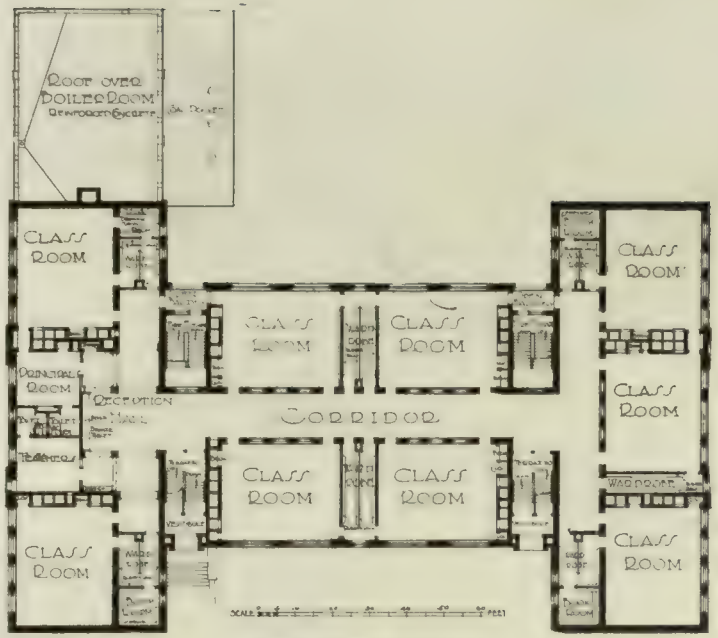
WILLIAMS SCHOOL
CHELSEA, MASS.

KILHAM & HOPKINS
ARCHITECTS



SHURTLEFF SCHOOL
CHELSEA, MASS.

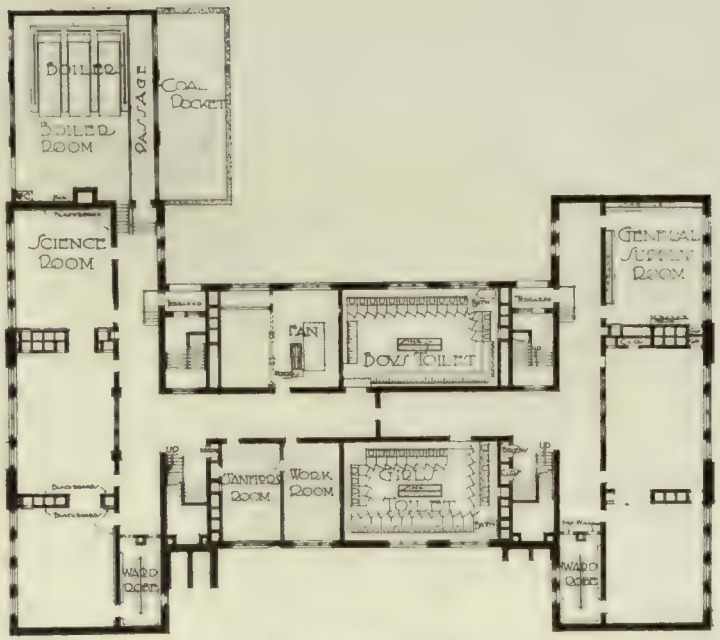
KILHAM & HOPKINS
ARCHITECTS



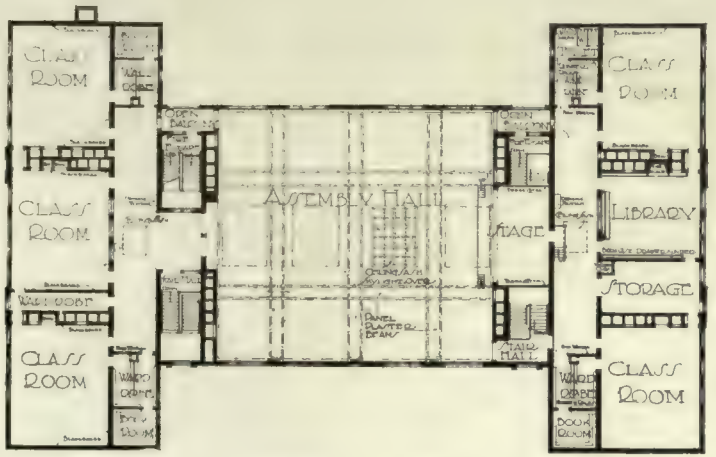
FIRST FLOOR PLAN

SHURTLEFF SCHOOL
CHELSEA, MASS.

KILHAM & HOPKINS
ARCHITECTS



BASEMENT PLAN



THIRD FLOOR PLAN

This structure is one of two wings that have been planned and which will eventually be connected by means of the low, fireproof boiler house. Through this boiler house will run a wide corridor so that there will be easy access from one wing to the other. This plan gives an example of the H type of building which affords a better opportunity of lighting the large rooms than the other well-known types. The red water-struck brick of the exterior blends harmoniously with the white terra cotta, presenting a very bold design at the corners as compared with the rather open and delicate style of the central feature. The mullioned windows are arranged so as to furnish the largest amount of light possible.

There are 29 classrooms, besides manual training and domestic science rooms, which accommodate a total of one thousand four hundred and fifty pupils. These rooms have burlap dadoes with tinted plaster above. The blackboards throughout are of slate. The floors are of rift Georgia pine, while the rest of the woodwork is of slashed oak. There are four stairways from the basement to the top floor, two of which are closed in and are only accessible from an open balcony, which allows of escape in case of fire by means of an avenue shut off from the rest of the building, and hence proof against smoke.

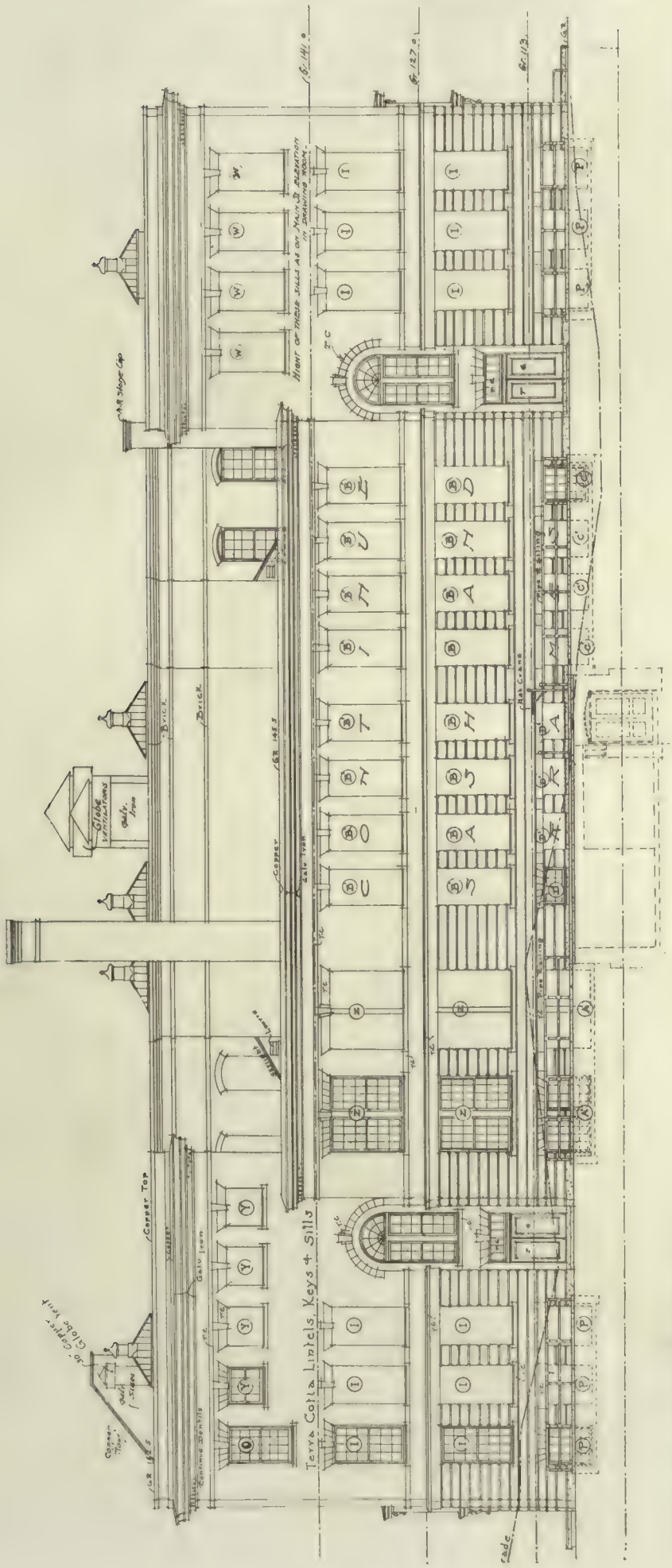
The indirect system of steam-heating by means of fans is used in this school, together with an automatic device for temperature control.

The cubical contents of the building is 1,041,646 cubic feet, while the entire cost is $161,203. The cost per cubic foot is about 16 cents and the cost per pupil about $114. This includes built-in filing cases for the master, a large amount of book and supply storage space and shelving desired by the authorities and a handsome library with glass bookcases, fireplace, etc.

HAVERHILL HIGH SCHOOL, HAVERHILL, MASS.
KILHAM & HOPKINS, ARCHITECTS

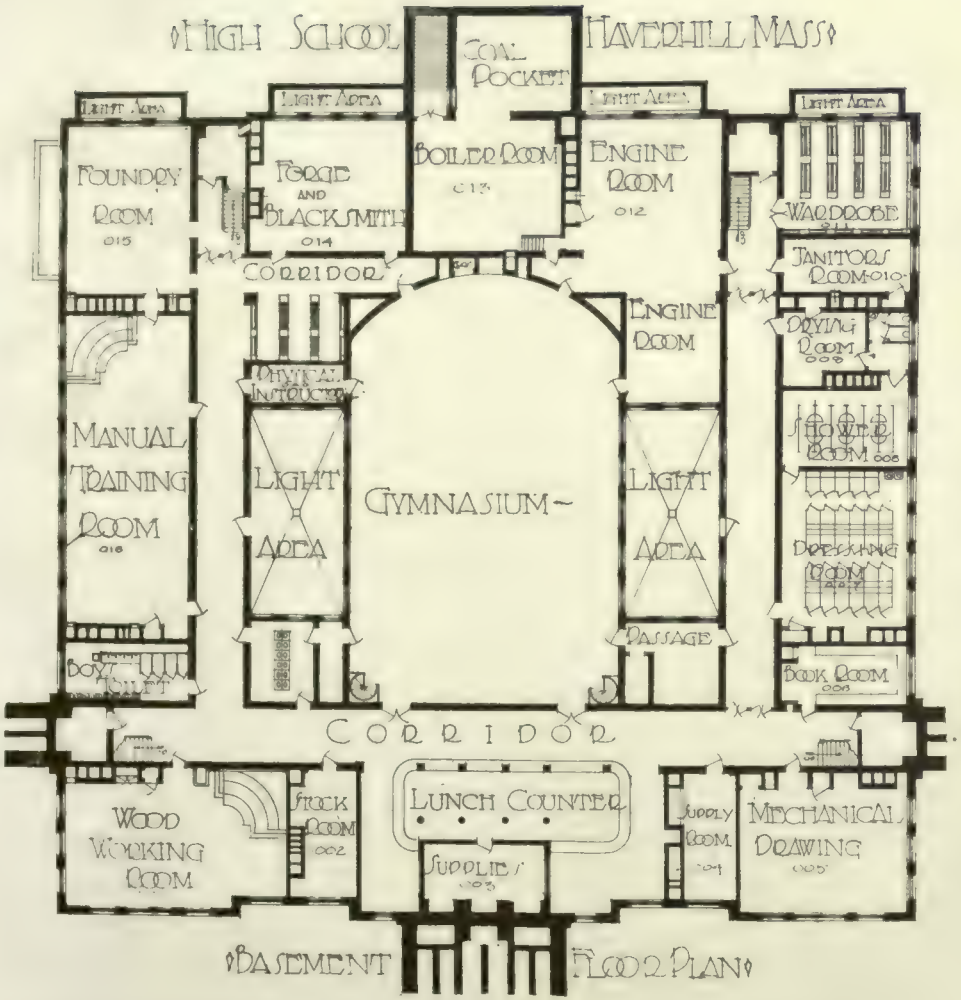
This school accommodates about 900 pupils and is in the form of a hollow square, with the gymnasium and assembly hall in the center. The gymnasium occupies the basement and first floor and is lighted from a large well on each side. The assembly hall occupies the space in the second and third stories directly over the gymnasium. The building cost about $275,000 completely furnished, or 17 cents per cubic foot.

Every room and corridor is exceptionally well lighted. The electric equipment throughout is of highest grade.



KILHAM & HOPKINS
ARCHITECTS

HAVERHILL HIGH SCHOOL
HAVERHILL, MASS.



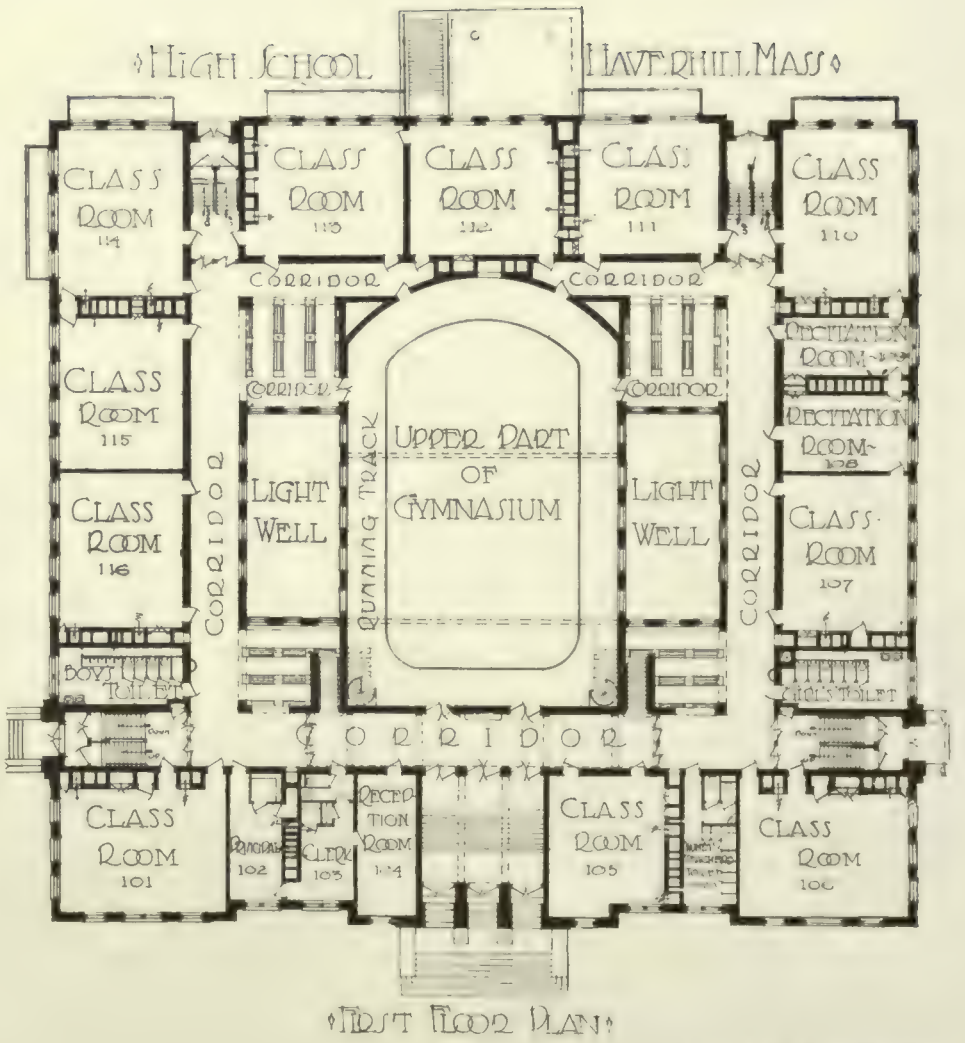
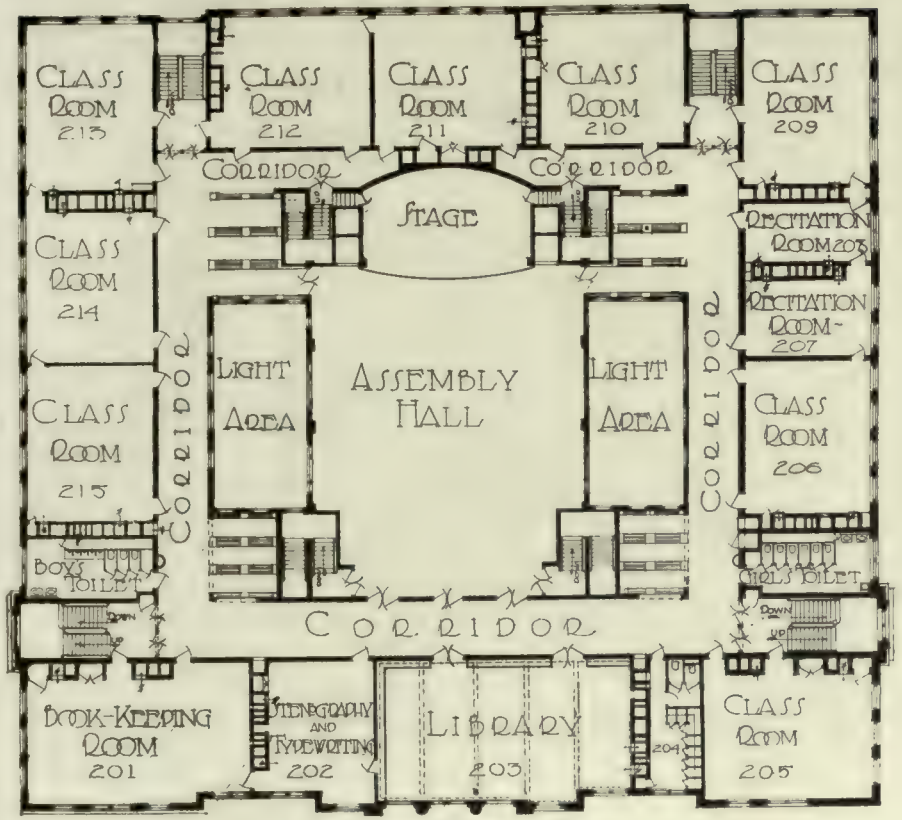


Plate 129

HAVERHILL HIGH SCHOOL,
HAVERHILL, MASS.

KILLAM & HOPKINS
ARCHITECTS

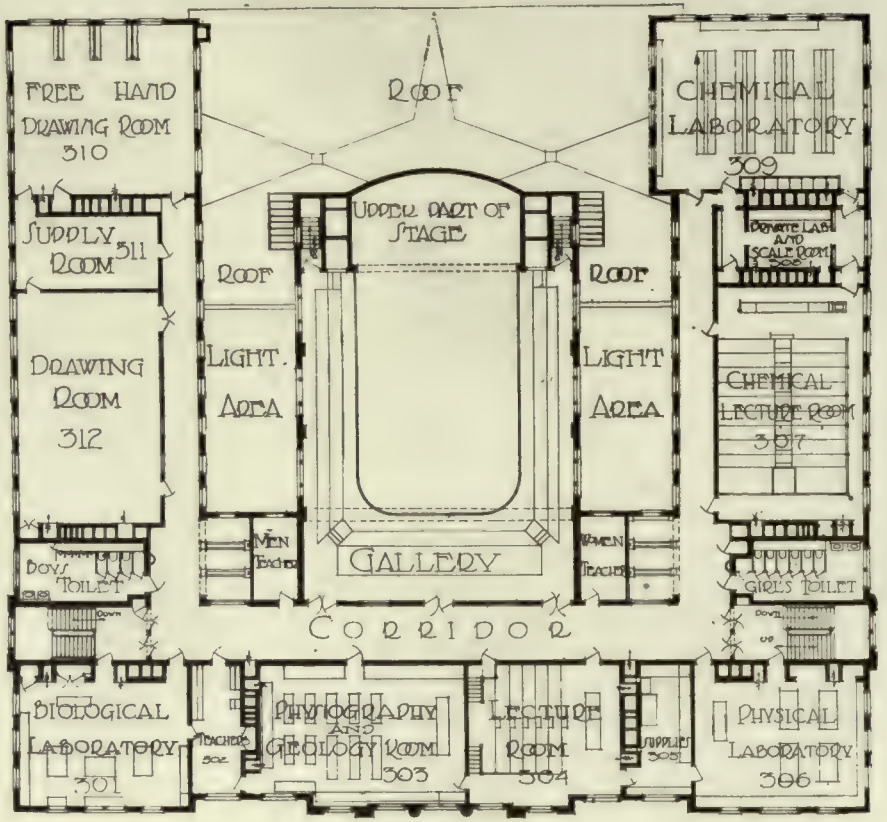
HIGH SCHOOL HAVERHILL MASS



SECOND FLOOR PLAN

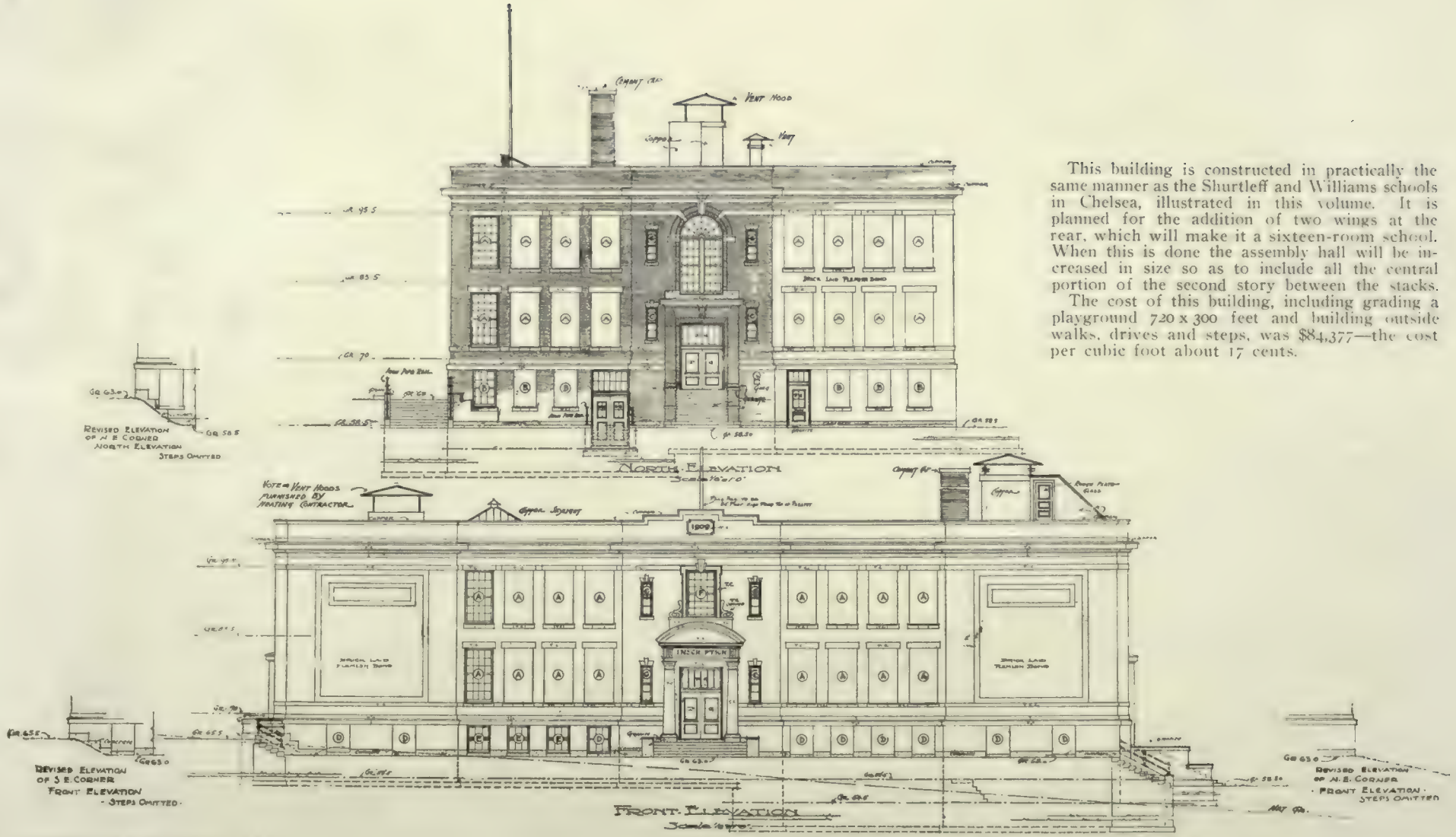
HAVERHILL HIGH SCHOOL
HAVERHILL, MASS.

HIGH SCHOOL HAVERHILL MASS



THIRD FLOOR PLAN

KILHAM & HOPKINS
ARCHITECTS

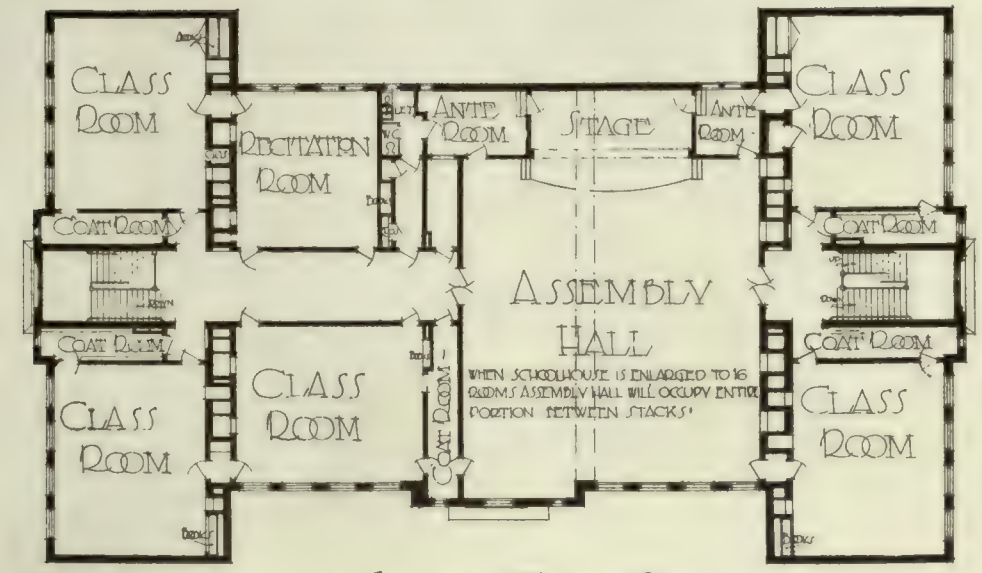

NORTH ELEVATION
FRONT ELEVATION
REVISED ELEVATION OF N.E. CORNER NORTH ELEVATION STEPS OMITTED
REVISED ELEVATION OF S.E. CORNER FRONT ELEVATION - STEPS OMITTED
REVISED ELEVATION OF N.E. CORNER - FRONT ELEVATION - STEPS OMITTED
VENT HOOD
1909

This building is constructed in practically the same manner as the Shurtleff and Williams schools in Chelsea, illustrated in this volume. It is planned for the addition of two wings at the rear, which will make it a sixteen-room school. When this is done the assembly hall will be increased in size so as to include all the central portion of the second story between the stacks.

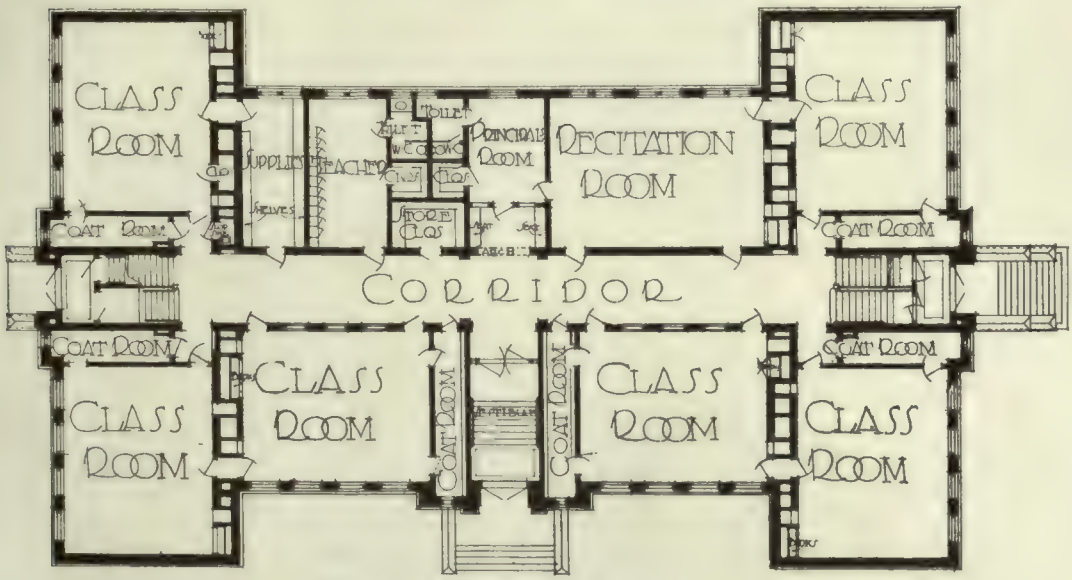
The cost of this building, including grading a playground 720 x 300 feet and building outside walks, drives and steps, was $84,377—the cost per cubic foot about 17 cents.

SCHOOL AT MILTON, MASS.

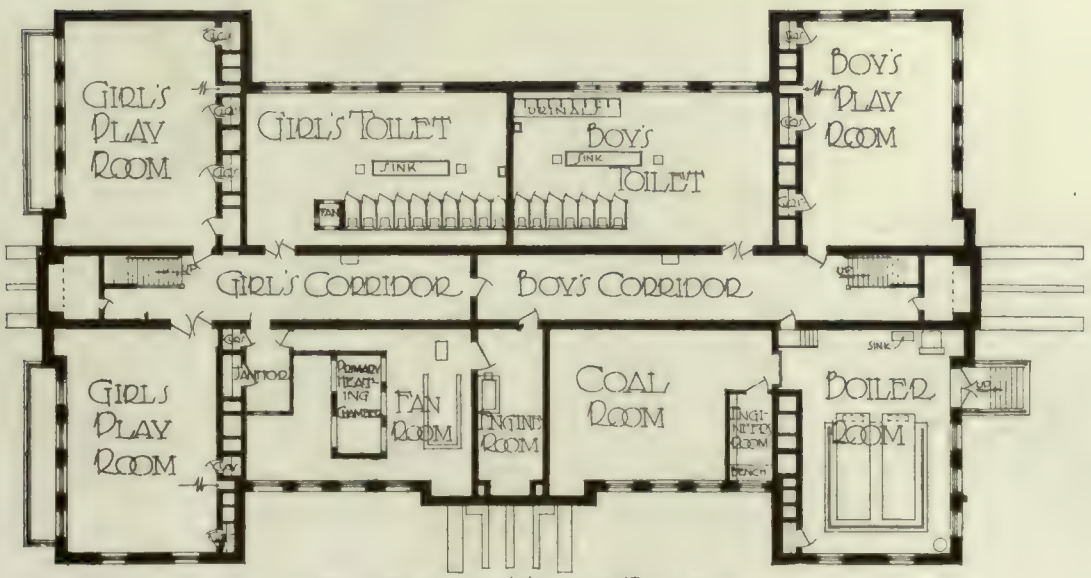
KILHAM & HOPKINS, ARCHITECTS



SECOND FLOOR PLAN



FIRST FLOOR PLAN



BASEMENT FLOOR PLAN

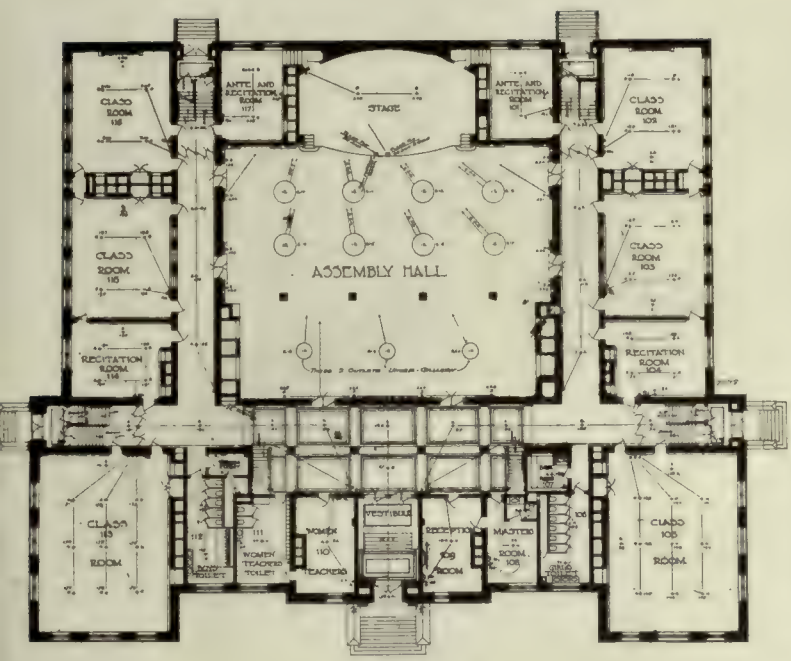
SCHOOL AT MILTON, MASS. KILHAM & HOPKINS, ARCHITECTS

Plate 133

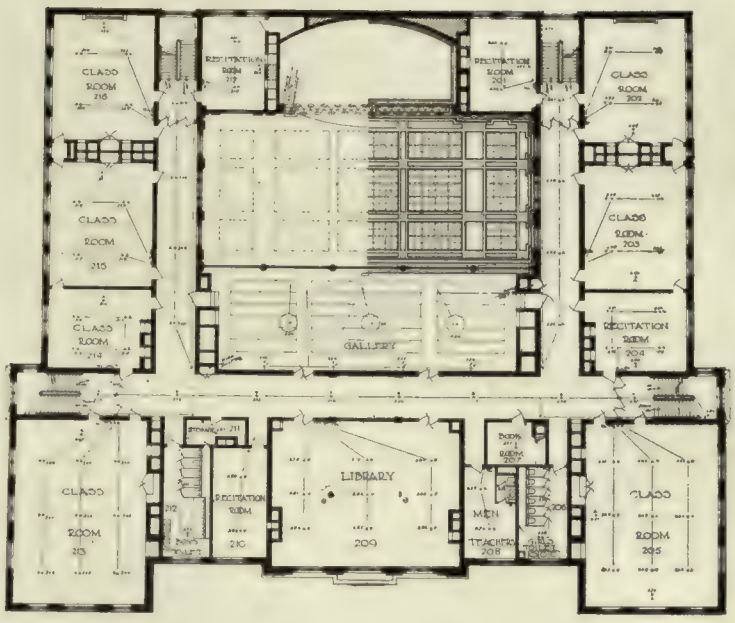
SALEM HIGH SCHOOL, SALEM, MASS.

KILHAM & HOPKINS, ARCHITECTS

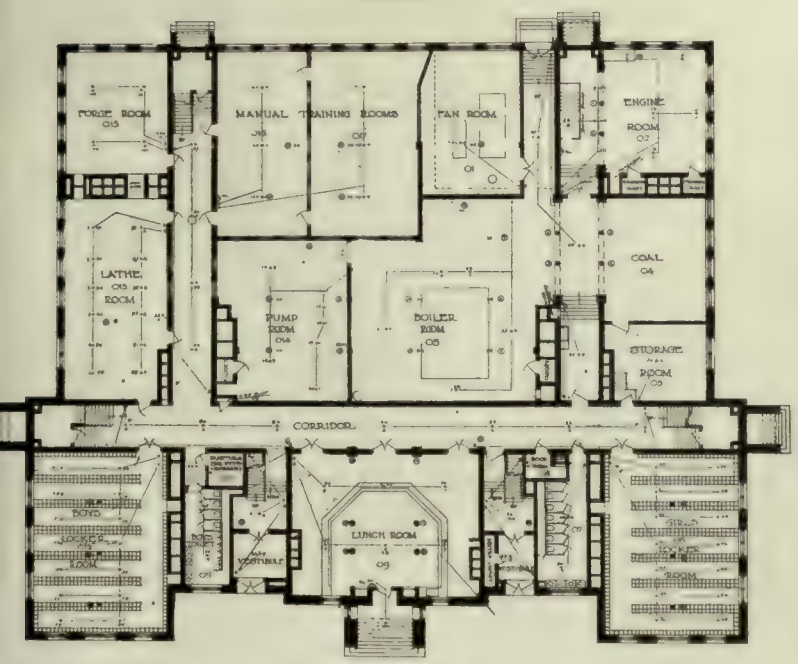
Material, red brick and white terra cotta. Accommodates 864 pupils. The plan is designed to allow for a future wing across the rear which will complete the quadrangle and make the side elevations symmetrical.



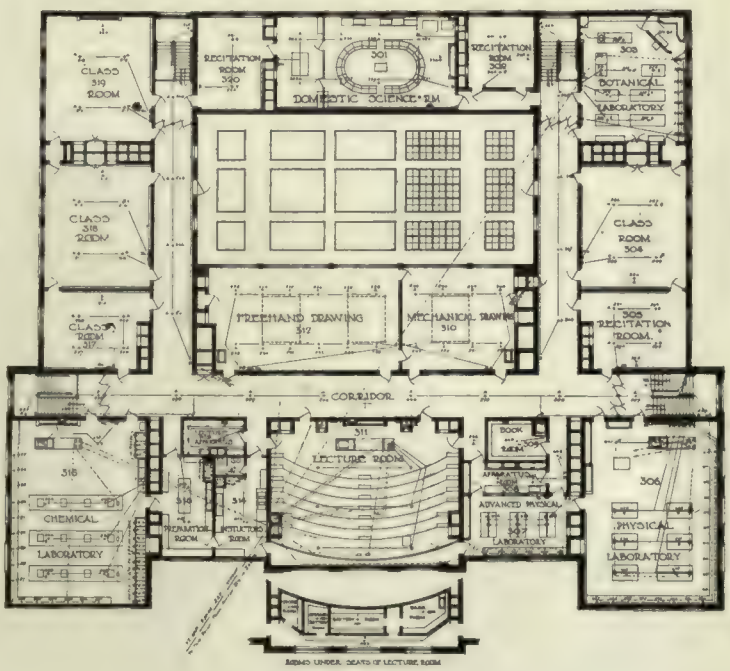
FIRST FLOOR PLAN



SECOND FLOOR PLAN



BASEMENT PLAN



THIRD FLOOR PLAN

SALEM HIGH SCHOOL
SALEM, MASS.

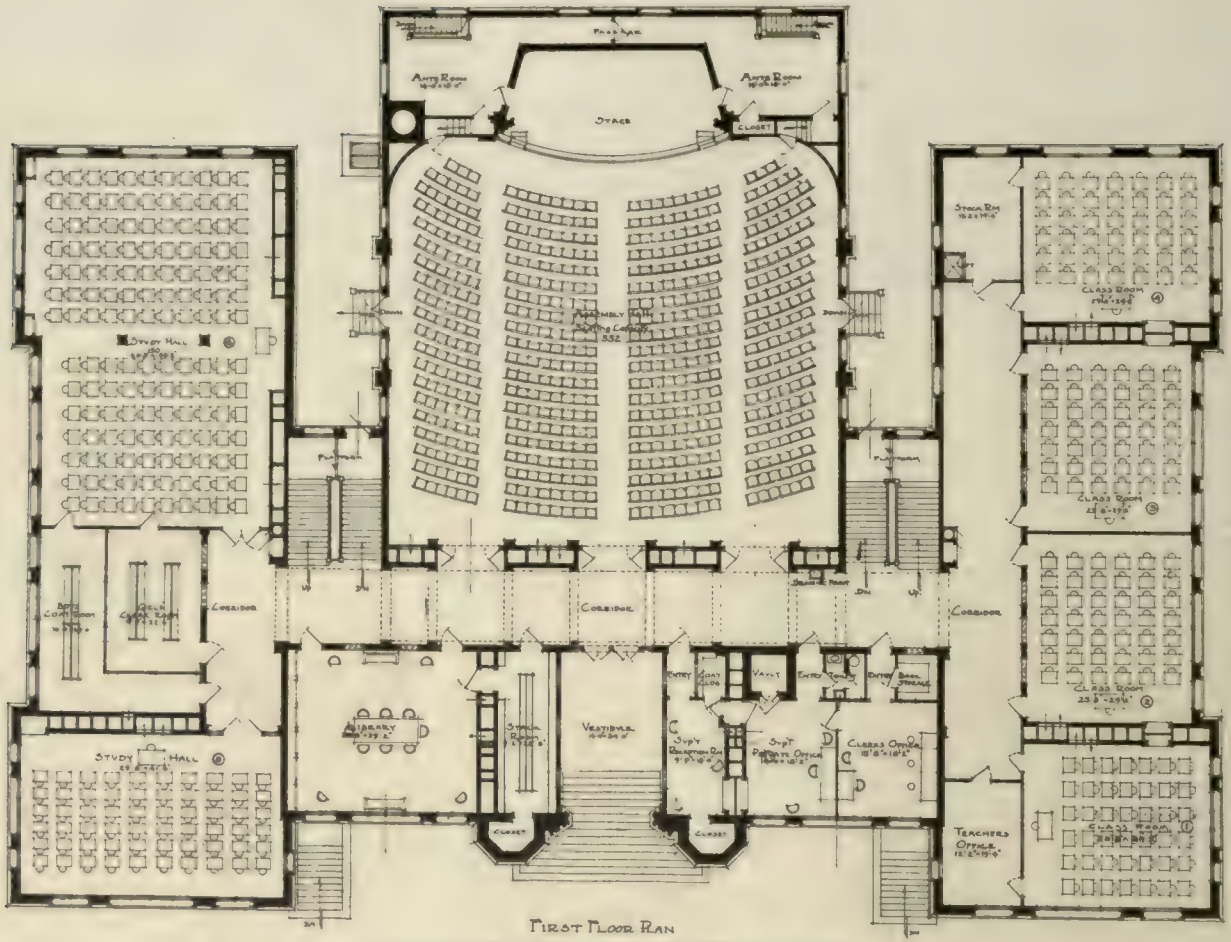
KILHAM & HOPKINS
ARCHITECTS

WHITE PLAINS HIGH SCHOOL
WHITE PLAINS, N. Y.

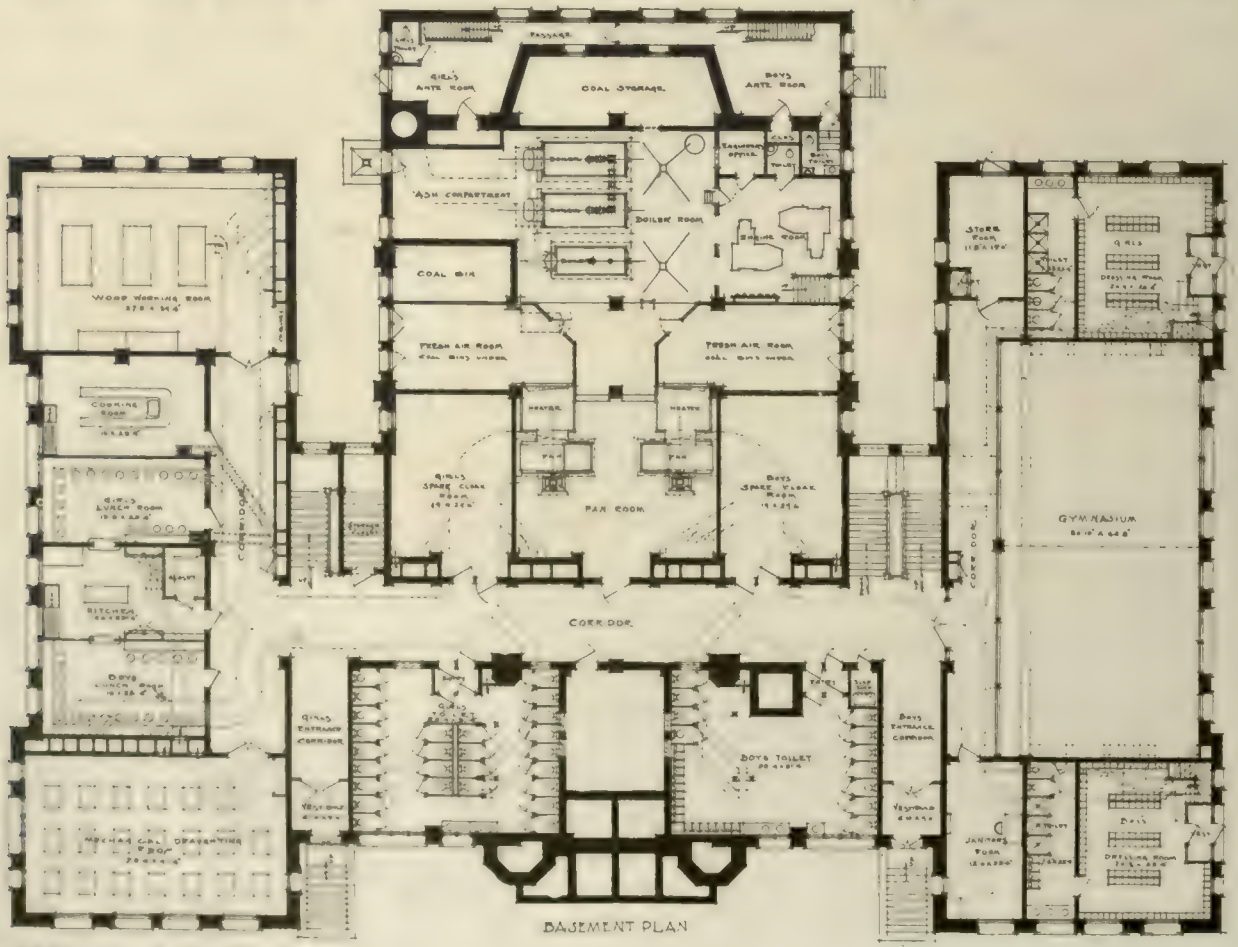
HENRY C. PELTON
ARCHITECT

WHITE PLAINS HIGH SCHOOL
WHITE PLAINS, N. Y.

HENRY C. PELTON
ARCHITECT



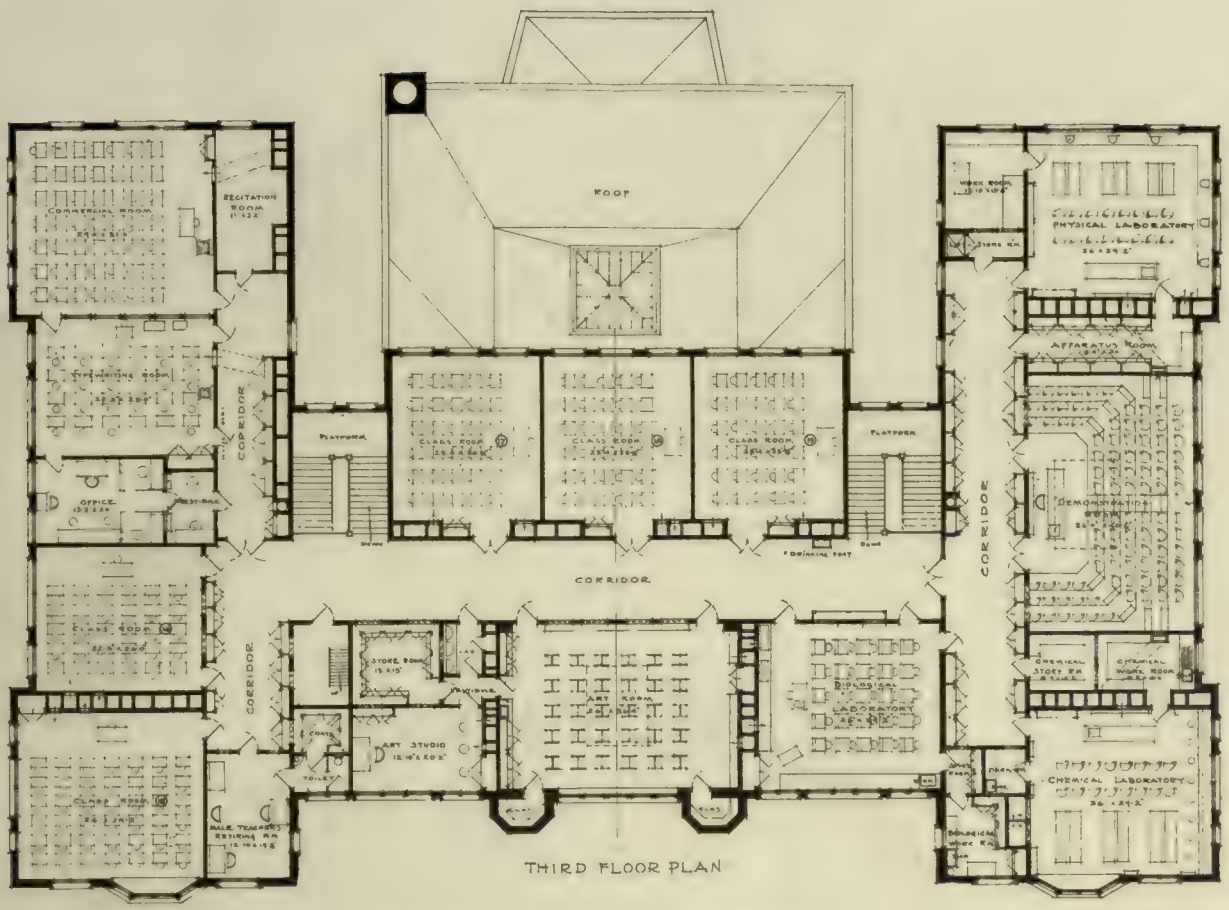
FIRST FLOOR PLAN

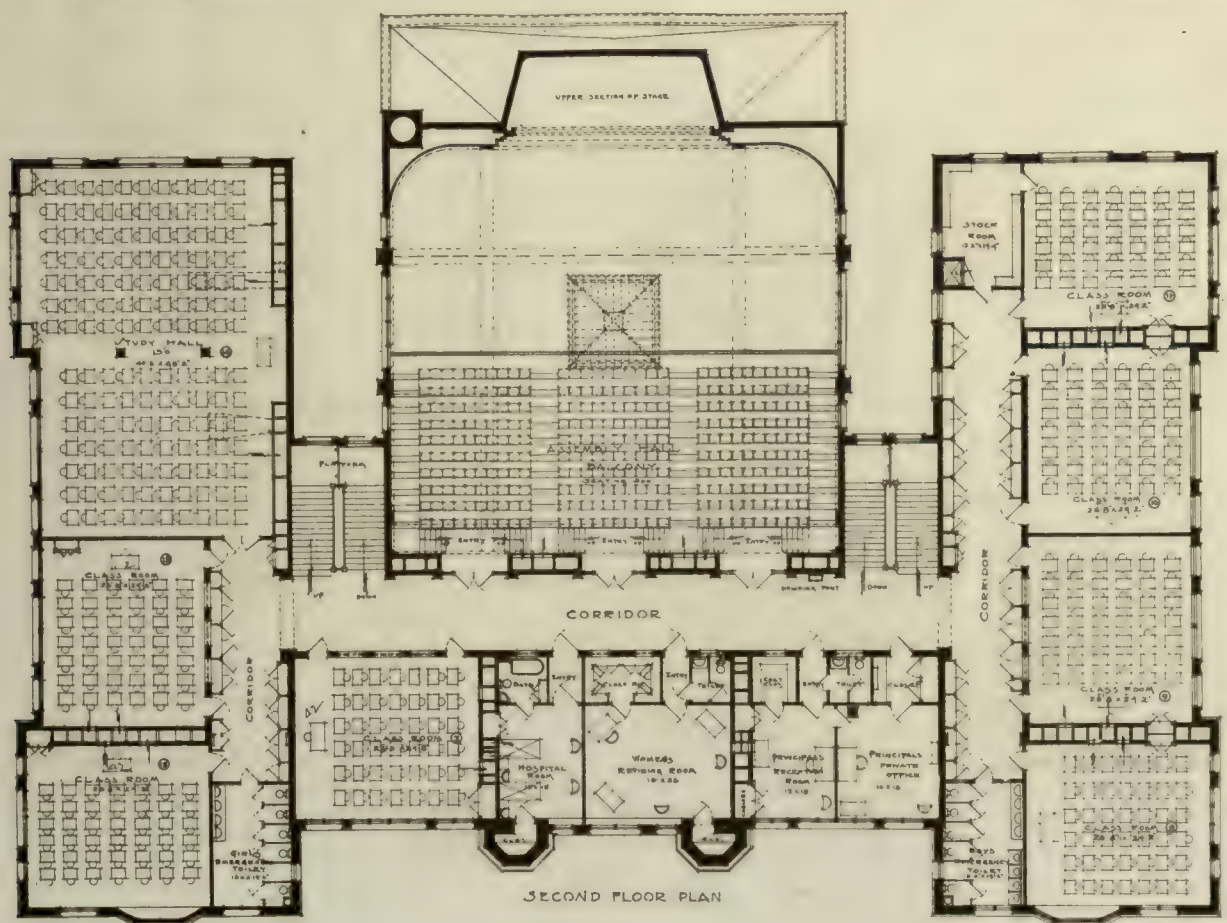


BASEMENT PLAN

WHITE PLAINS HIGH SCHOOL
WHITE PLAINS, N. Y.

HENRY C. PELTON
ARCHITECT



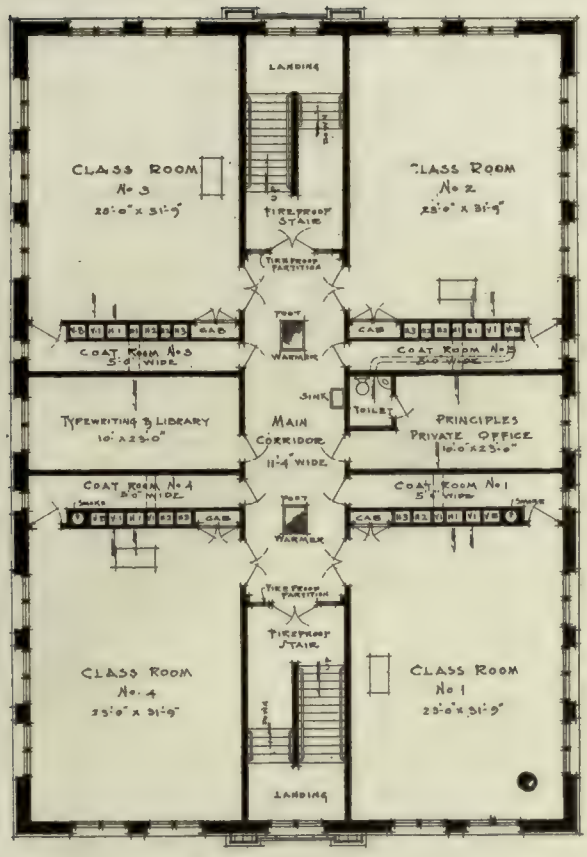


WHITE PLAINS HIGH SCHOOL
WHITE PLAINS, N. Y.

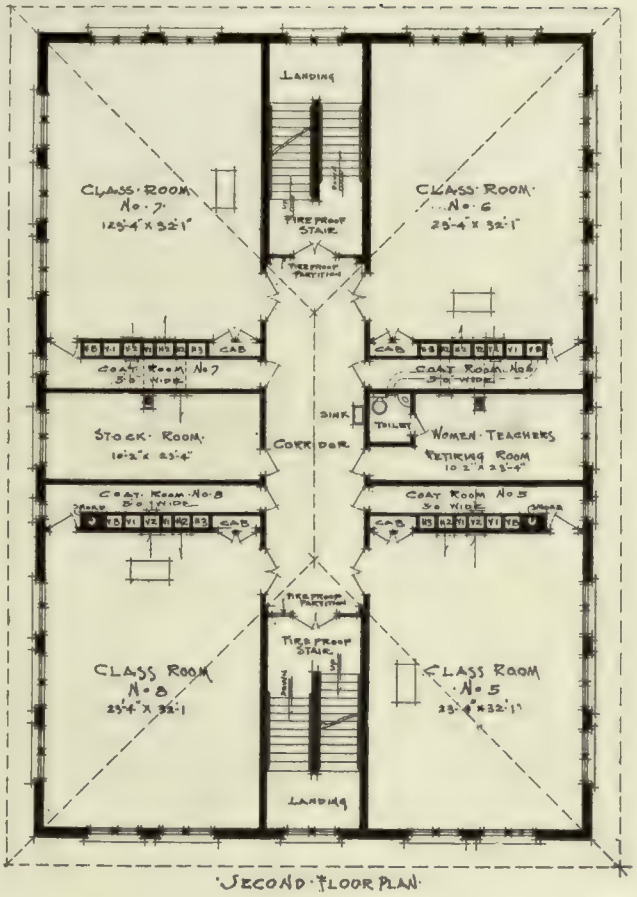
HENRY C. PELTON
ARCHITECT

HENRY C. PELTON
ARCHITECT

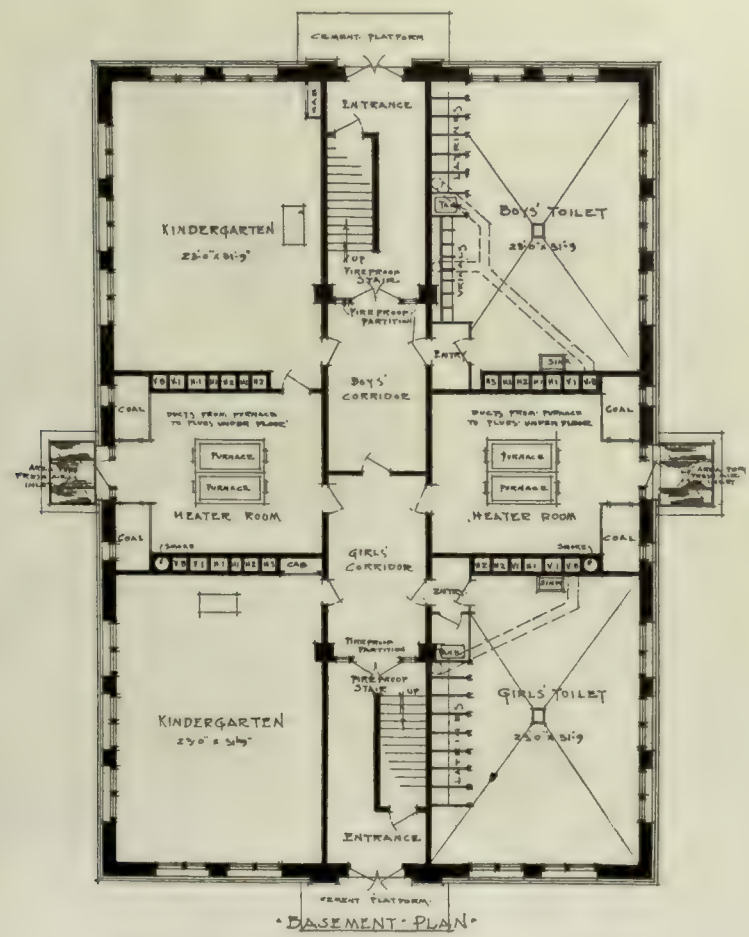
POINT PLEASANT SCHOOL
POINT PLEASANT, N. J.


LANDING
CLASS ROOM No. 3 28'-0" x 31'-9"
FIRE PROOF STAIR
CLASS ROOM No. 2 28'-0" x 31'-9"
FIRE PROOF PARTITION
COAT ROOM No. 3 5'-6" WIDE
COAT ROOM No. 2 5'-0" WIDE
TYPEWRITING & LIBRARY 10' x 23'-0"
MAIN CORRIDOR 11'-4" WIDE
SINK
TOILET
PRINCIPLES PRIVATE OFFICE 10'-0" x 23'-0"
COAT ROOM No. 4 5'-0" WIDE
COAT ROOM No. 1 5'-4" WIDE
CLASS ROOM No. 4 28'-0" x 31'-9"
CLASS ROOM No. 1 28'-0" x 31'-9"
LANDING

FIRST FLOOR PLAN


LANDING
CLASS ROOM No. 7 28'-4" x 32'-1"
FIRE PROOF STAIR
CLASS ROOM No. 6 28'-4" x 32'-1"
COAT ROOM No. 7 5'-6" WIDE
COAT ROOM No. 6 5'-0" WIDE
STOCK ROOM 10'-2" x 23'-4"
CORRIDOR
SINK
TOILET
WOMEN TEACHERS RETIRING ROOM 10'-2" x 23'-4"
COAT ROOM No. 8 5'-0" WIDE
COAT ROOM No. 5 5'-0" WIDE
CLASS ROOM No. 8 28'-4" x 32'-1"
CLASS ROOM No. 5 28'-4" x 32'-1"
LANDING

SECOND FLOOR PLAN



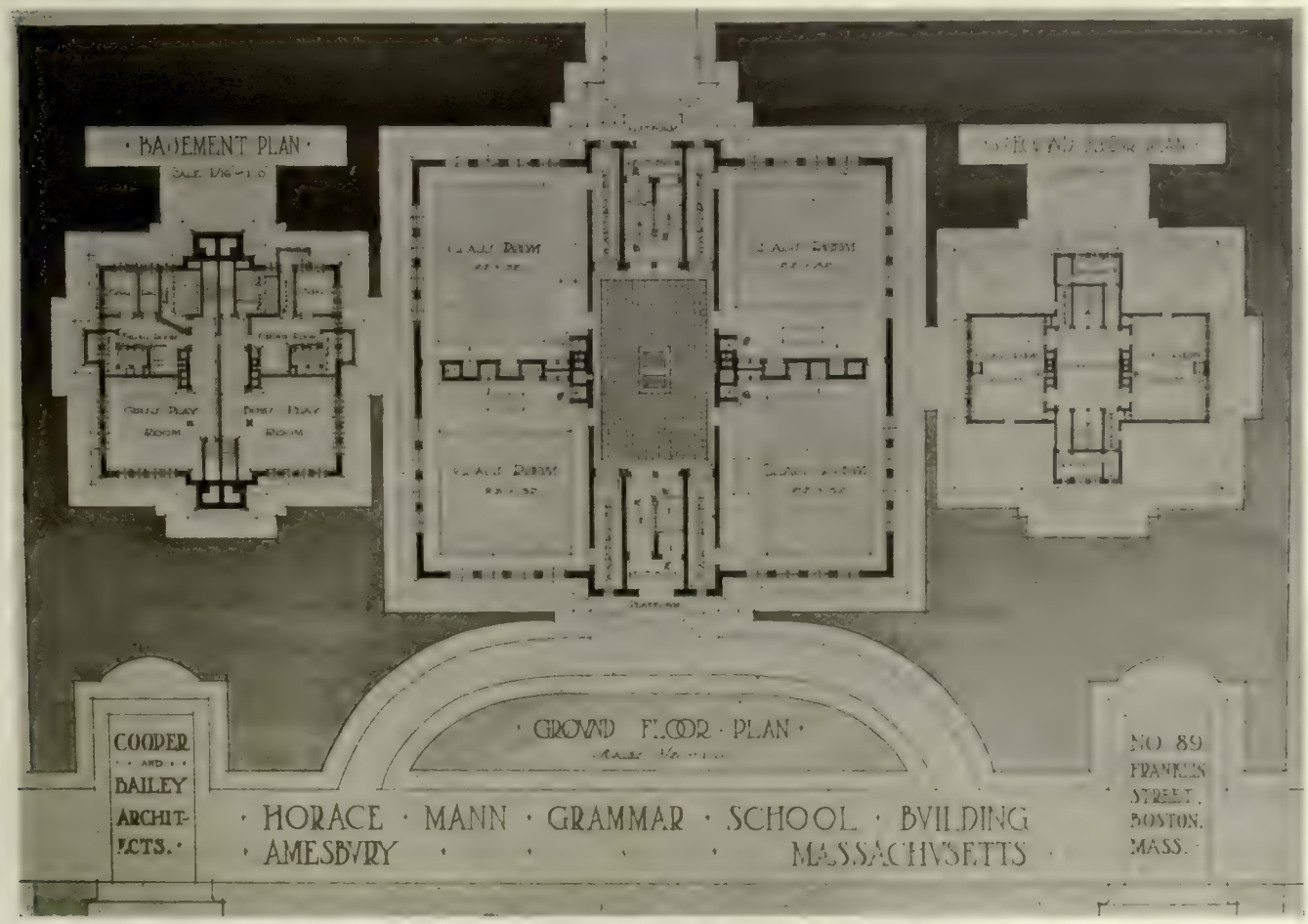
BASEMENT PLAN

POINT PLEASANT SCHOOL
POINT PLEASANT, N. J.

HENRY C. PELTON
ARCHITECT

HENRY C. PELTON
ARCHITECT

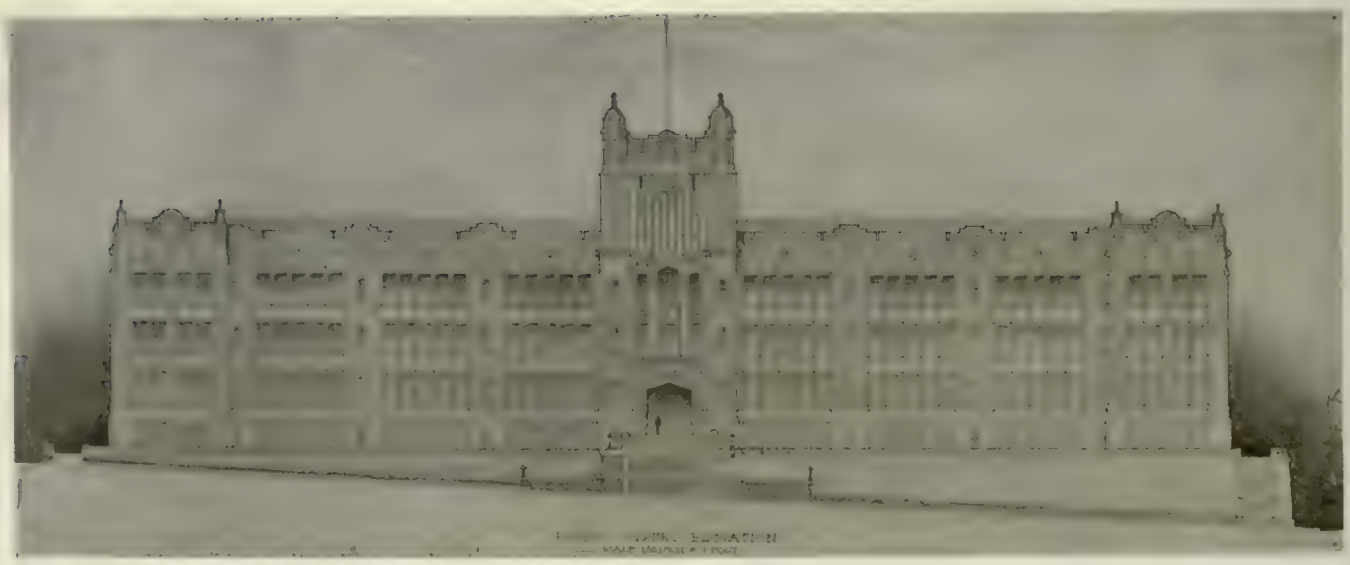
EATONTOWN SCHOOL
EATONTOWN, N. J.


· BASEMENT PLAN ·
· GROUND FLOOR PLAN ·
COOPER AND BAILEY ARCHITECTS.
· HORACE · MANN · GRAMMAR · SCHOOL · BVILDING
· AMESBVRY · · · · · MASSACHVSETTS
NO. 89 FRANKLIN STREET, BOSTON, MASS.

HORACE MANN GRAMMAR SCHOOL
AMESBURY, MASS.

COOPER & BAILEY
ARCHITECTS

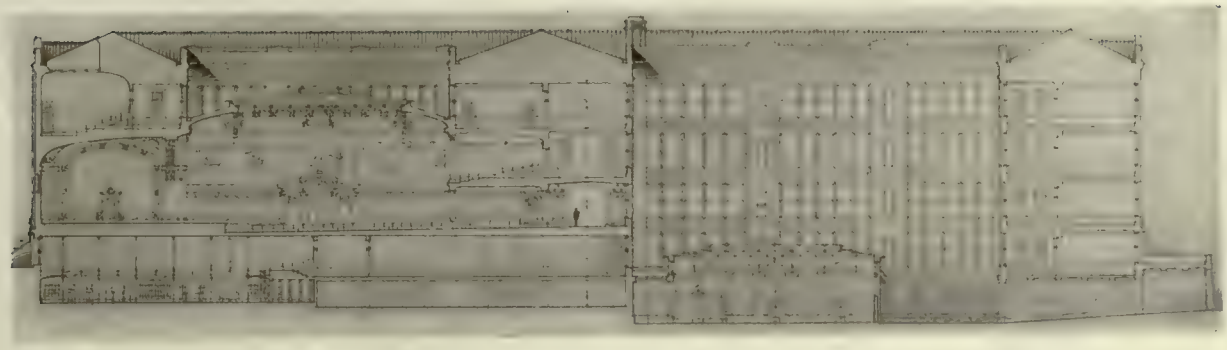
WEST ELEVATION



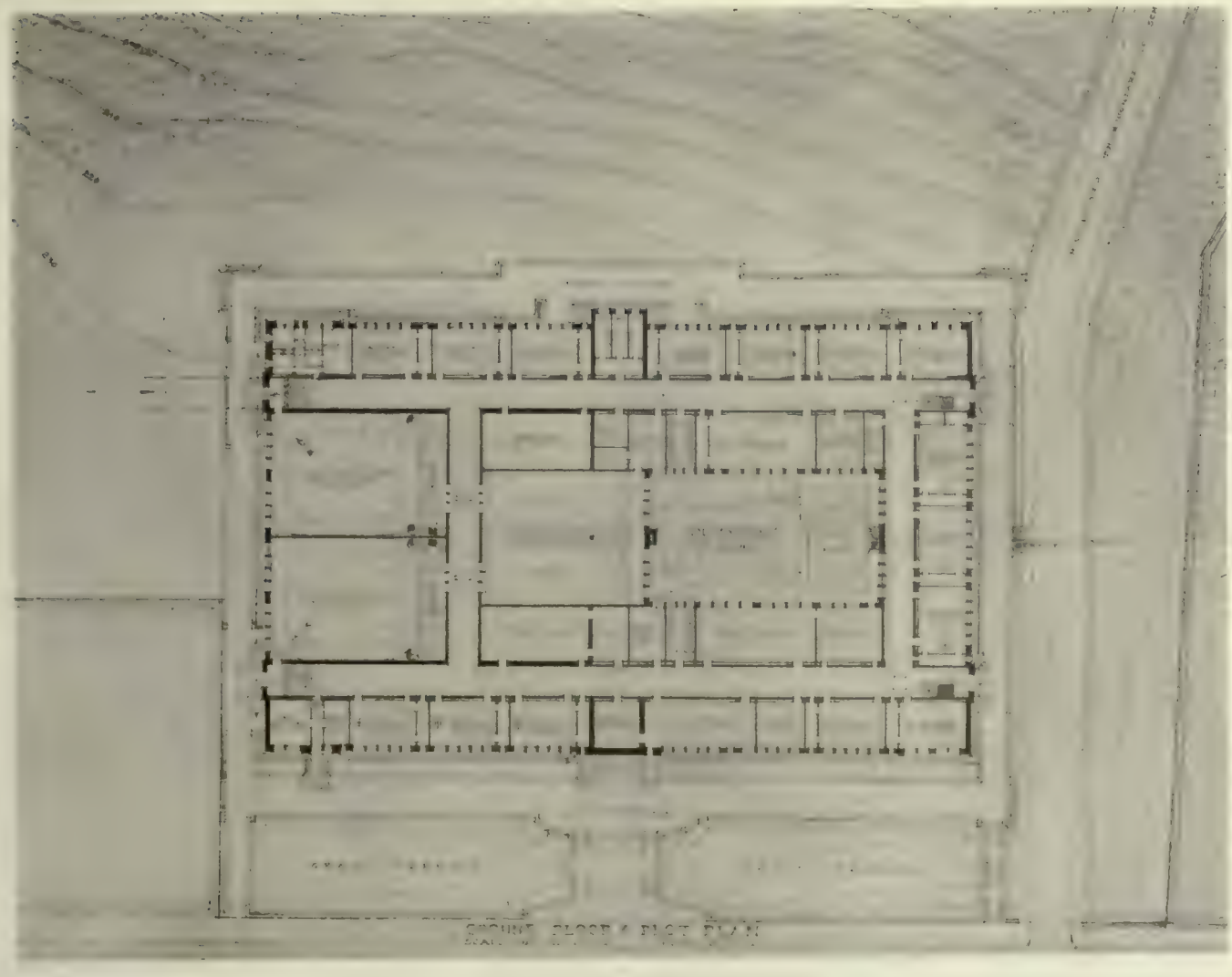
FORBES STREET ELEVATION

FIRST PRIZE DESIGNS
PITTSBURGH HIGH SCHOOL COMPETITION

RUTAN & RUSSELL
ARCHITECTS



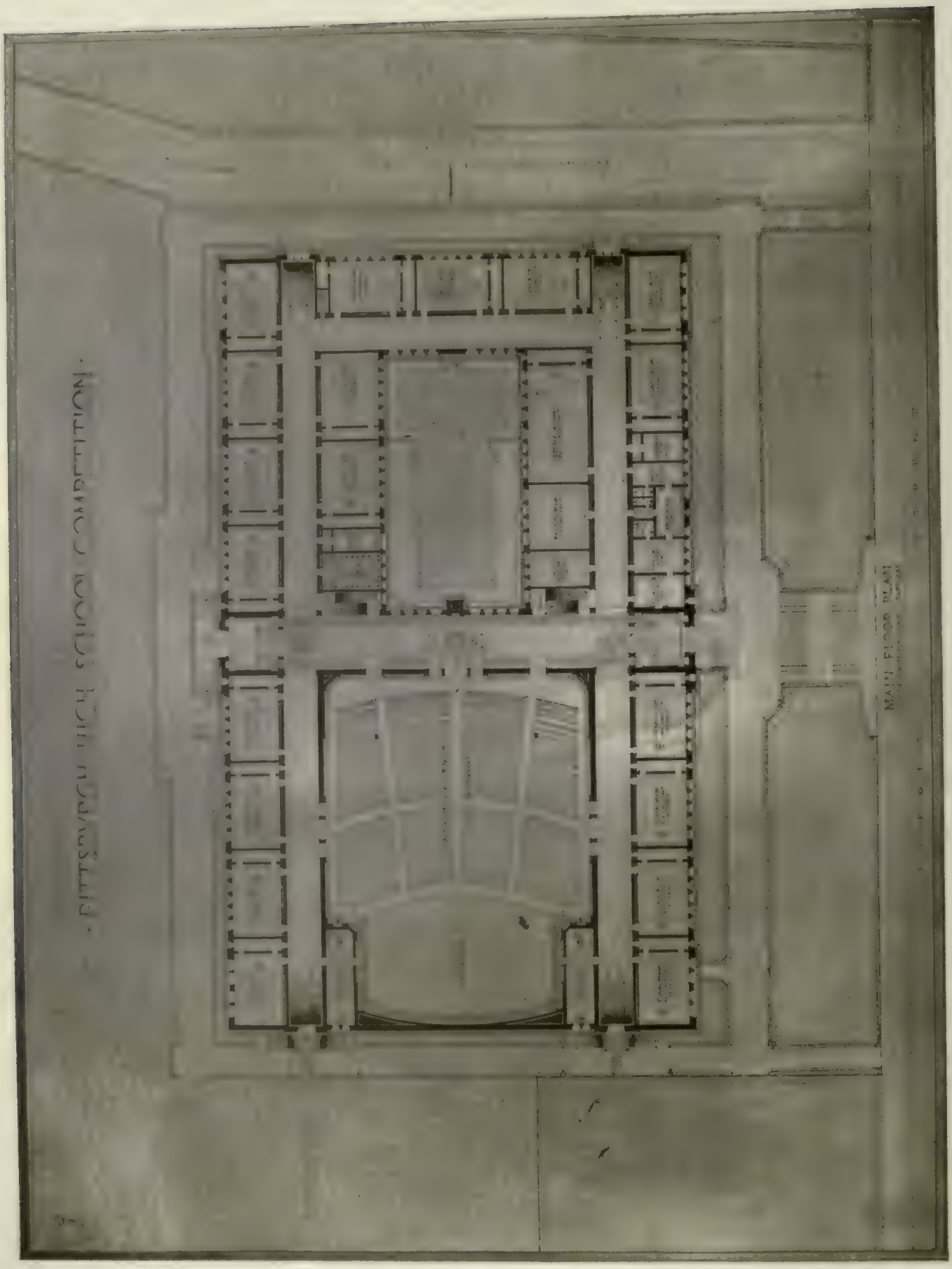
LONGITUDINAL SECTION



GROUND FLOOR AND PLOT PLAN

FIRST PRIZE DESIGNS
PITTSBURGH HIGH SCHOOL COMPETITION

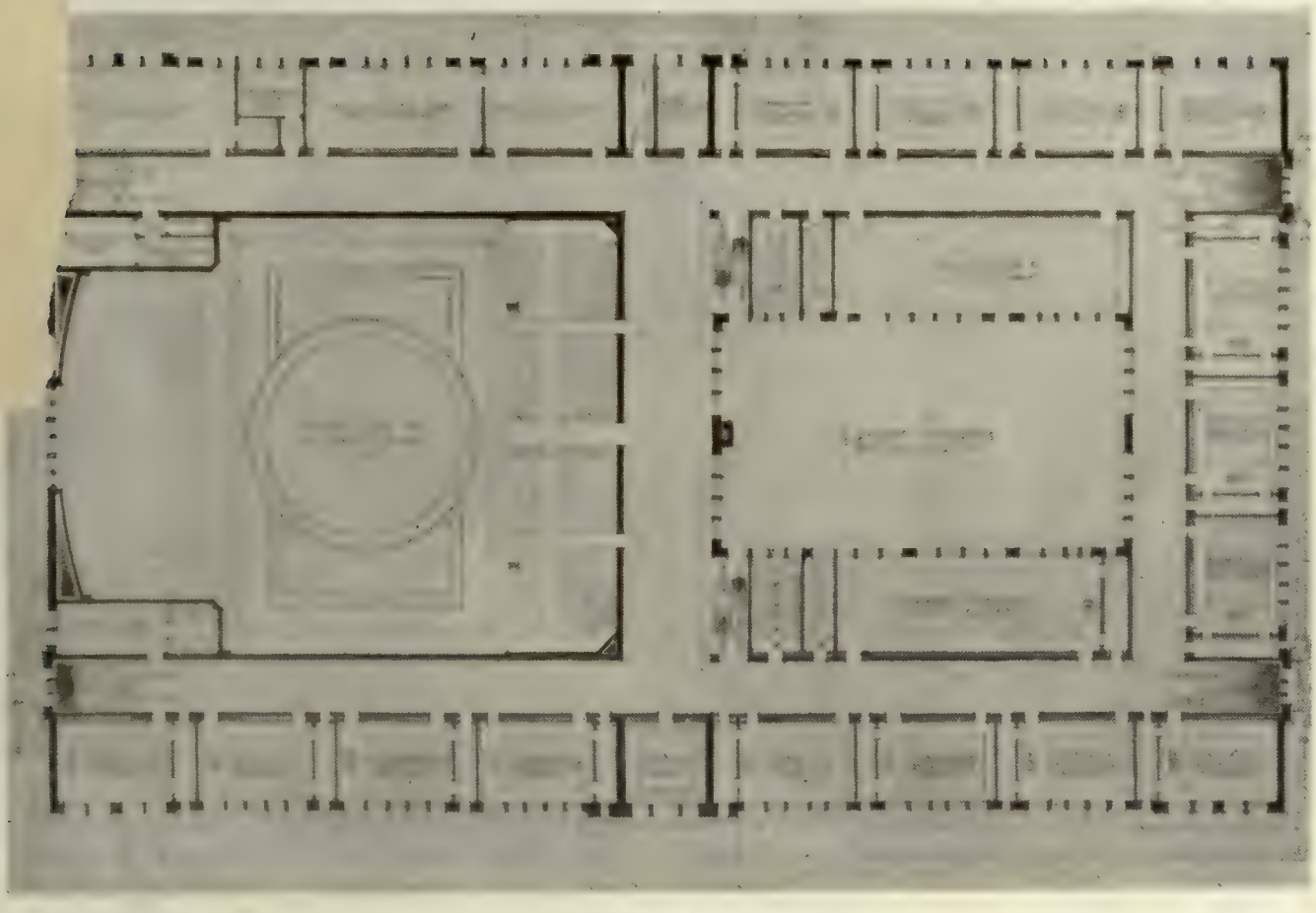
RUTAN & RUSSELL
ARCHITECTS



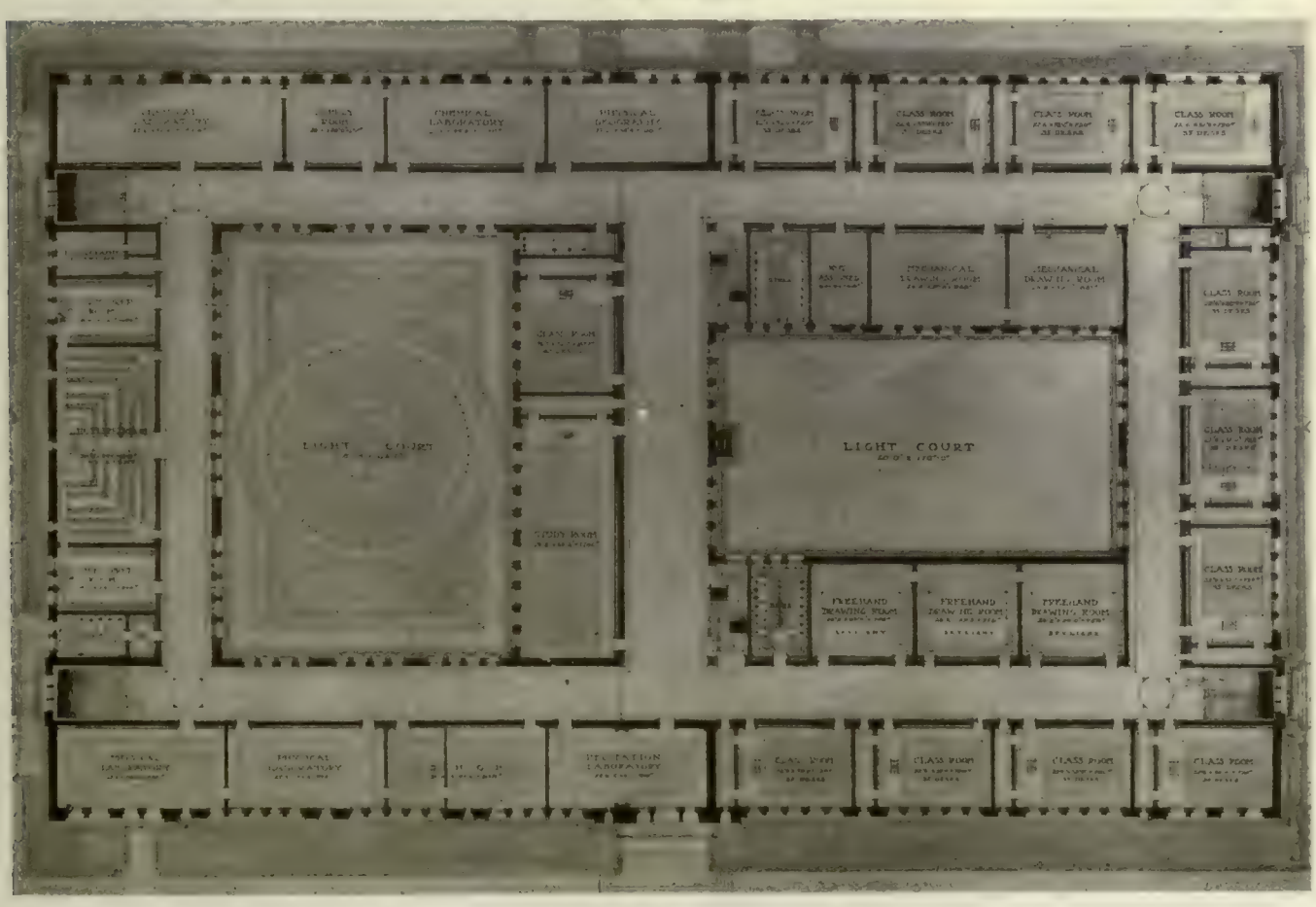
RUTAN & RUSSELL
ARCHITECTS

MAIN FLOOR PLAN

FIRST PRIZE DESIGNS
PITTSBURGH HIGH SCHOOL COMPETITION



THIRD FLOOR PLAN



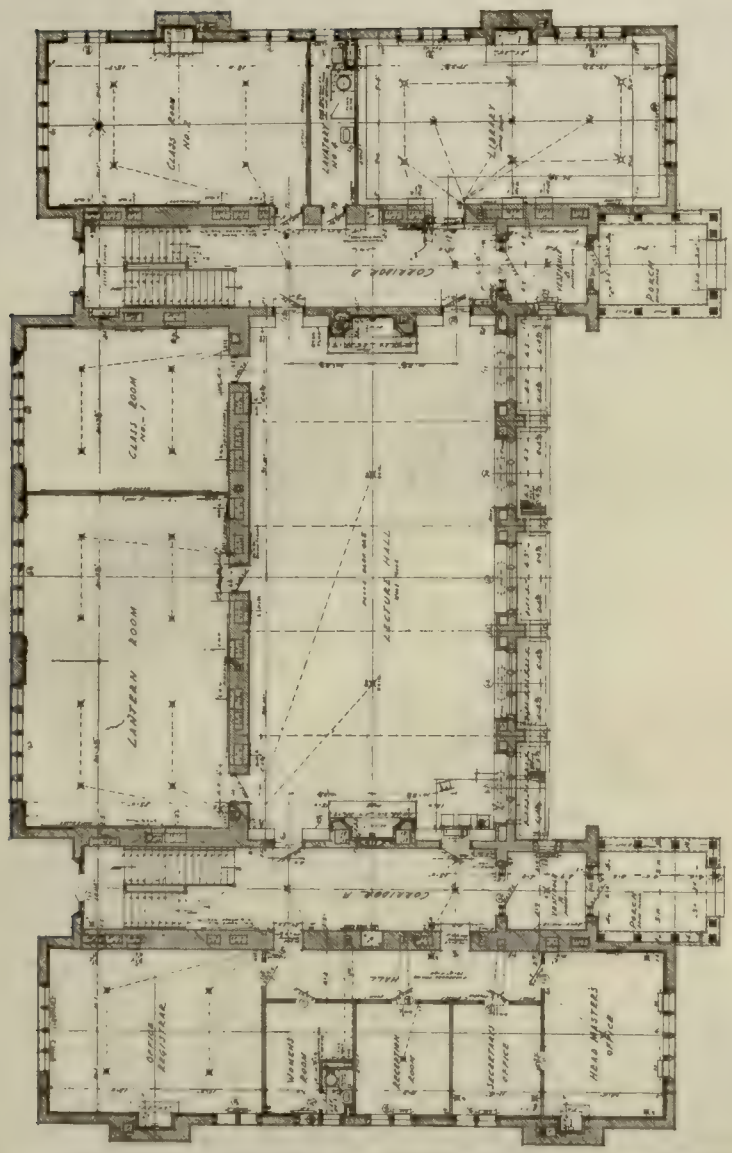
SECOND FLOOR PLAN

FIRST PRIZE DESIGNS
PITTSBURGH HIGH SCHOOL COMPETITION

RUTAN & RUSSELL
ARCHITECTS

NICHOLS SCHOOL
BUFFALO, NEW YORK

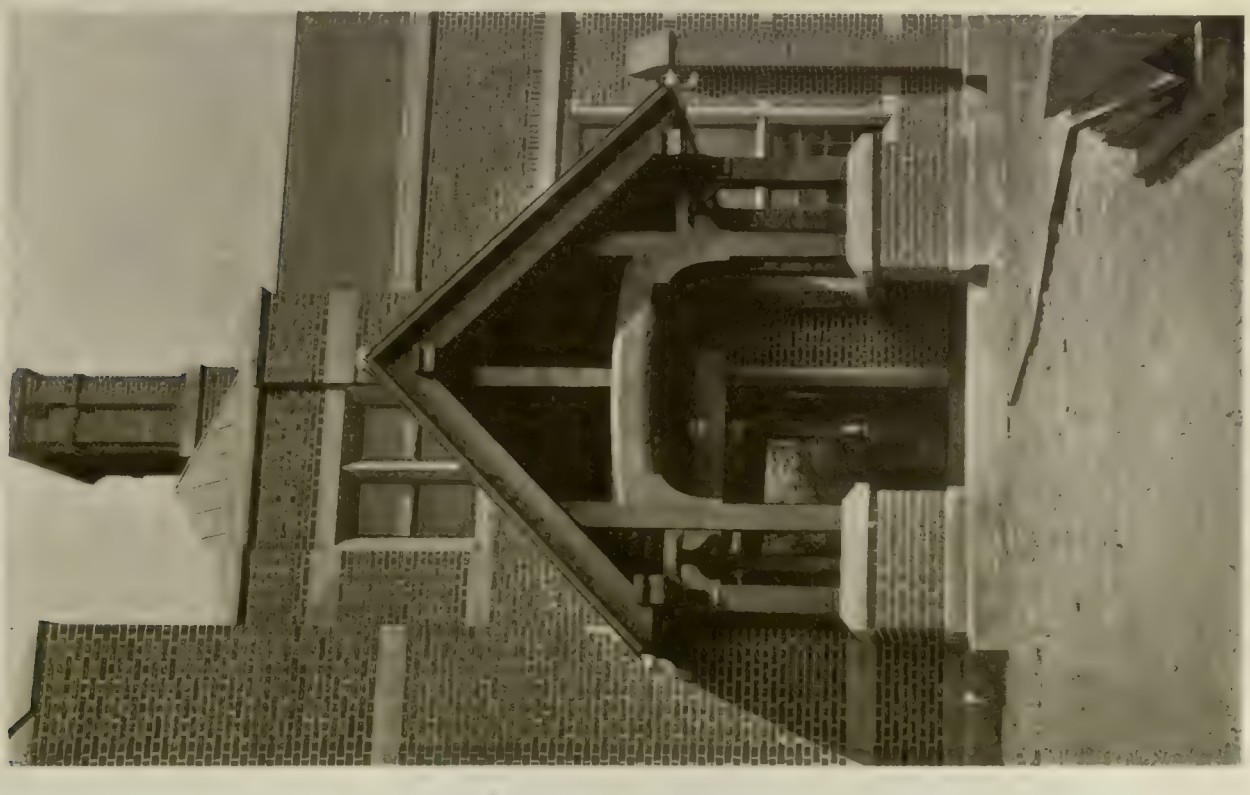
GREEN & WICKS
ARCHITECTS



DETAIL OF ENTRANCE AND FIRST FLOOR PLAN

NICHOLS SCHOOL, BUFFALO, NEW YORK

GREEN & WICKS, ARCHITECTS



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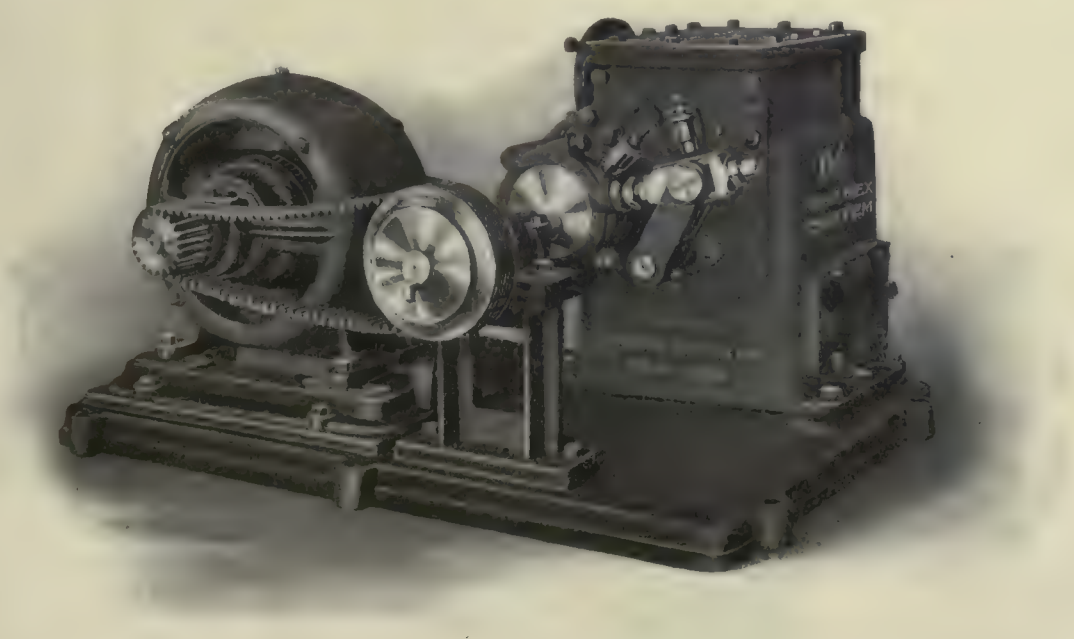

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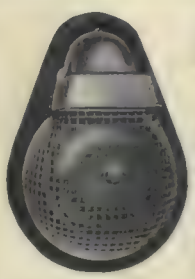

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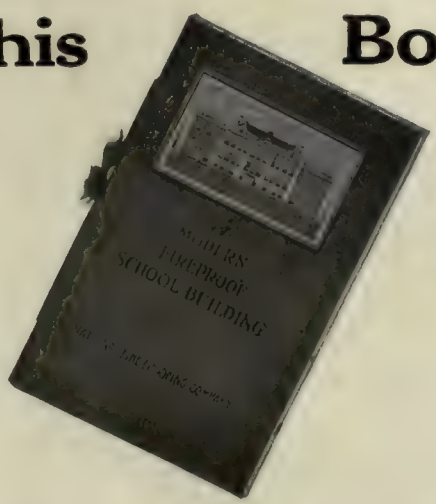

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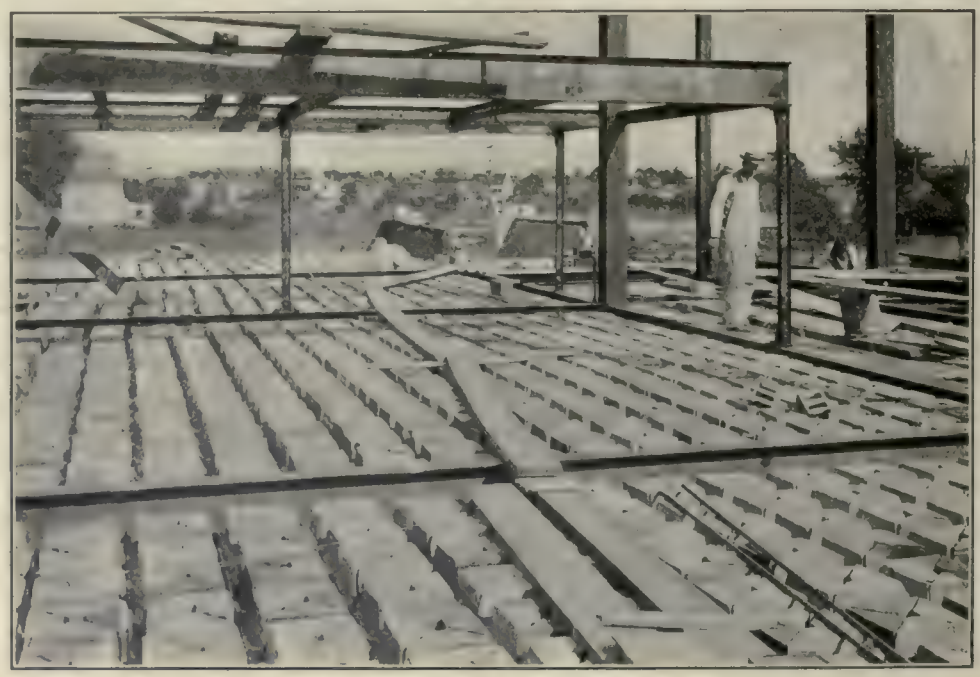

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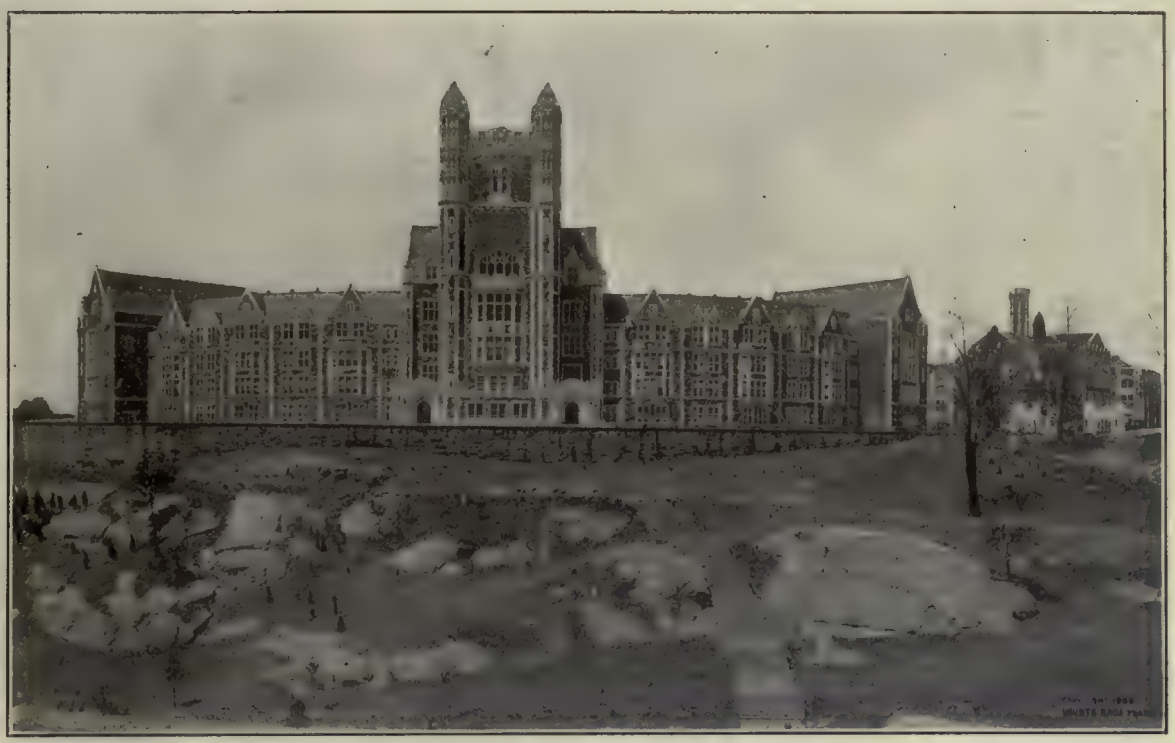

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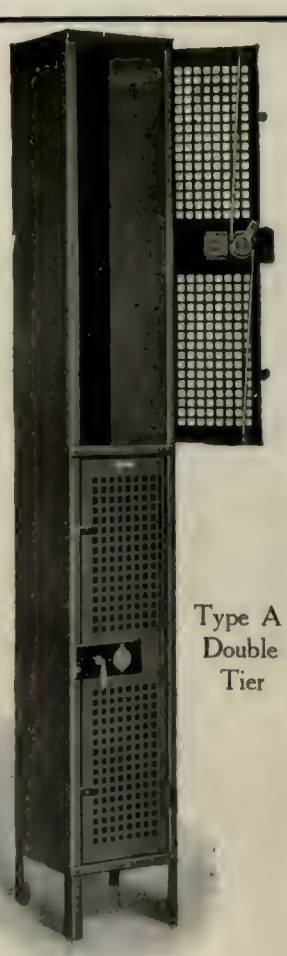

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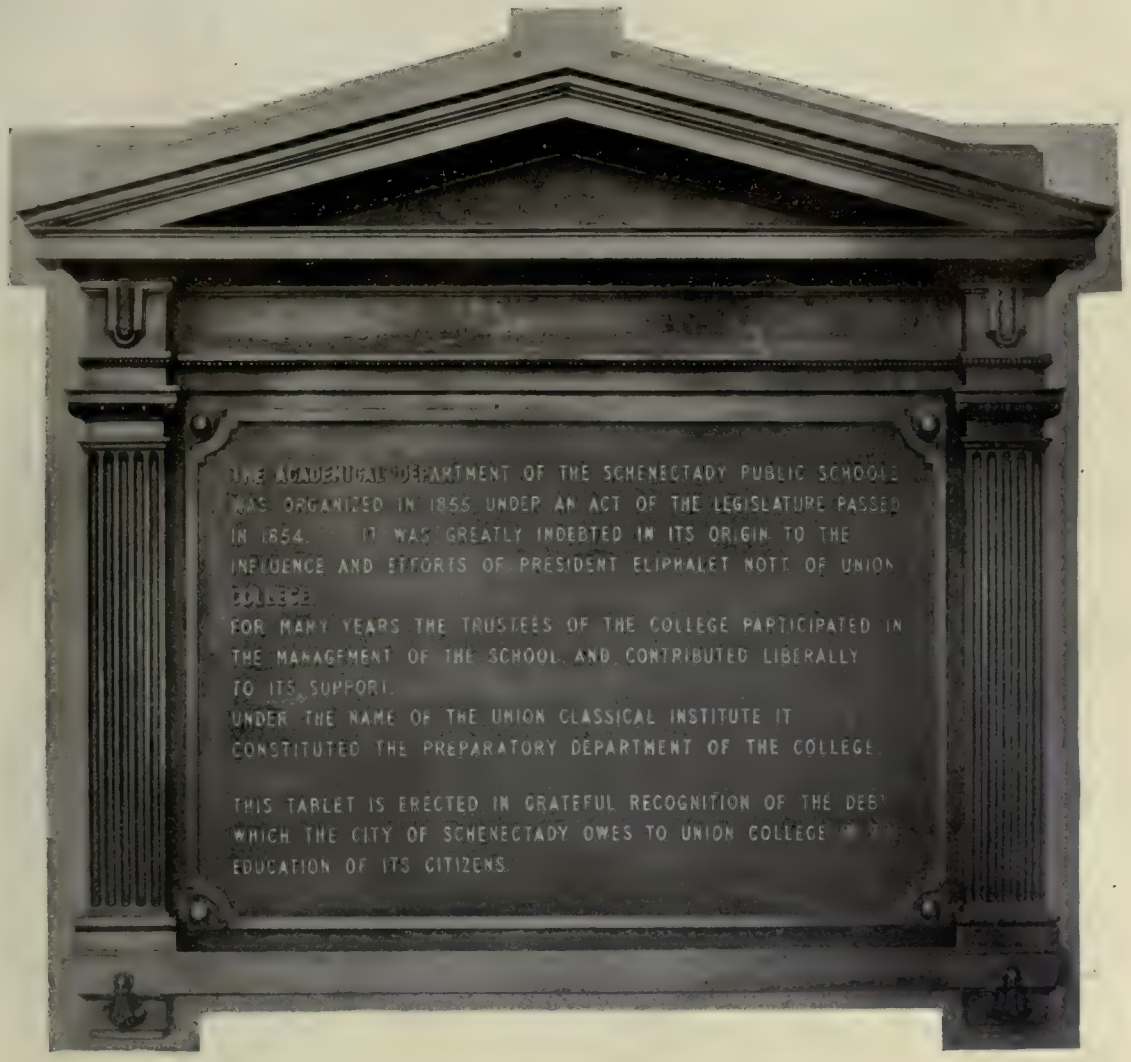
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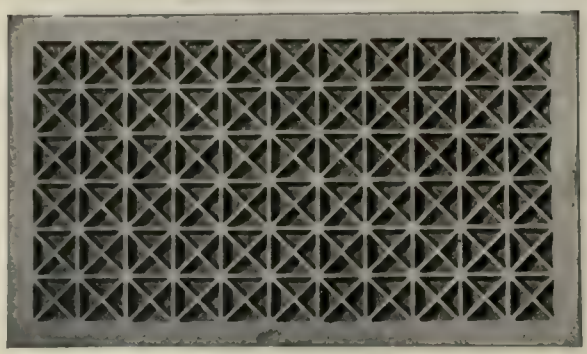

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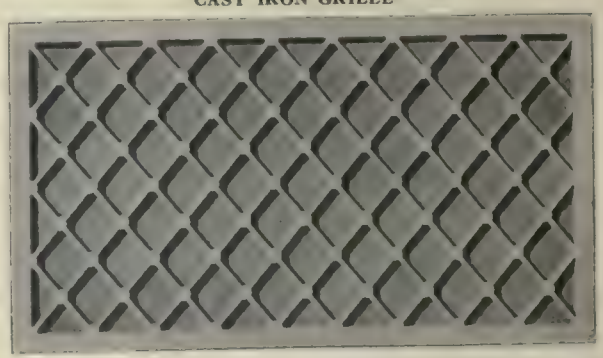

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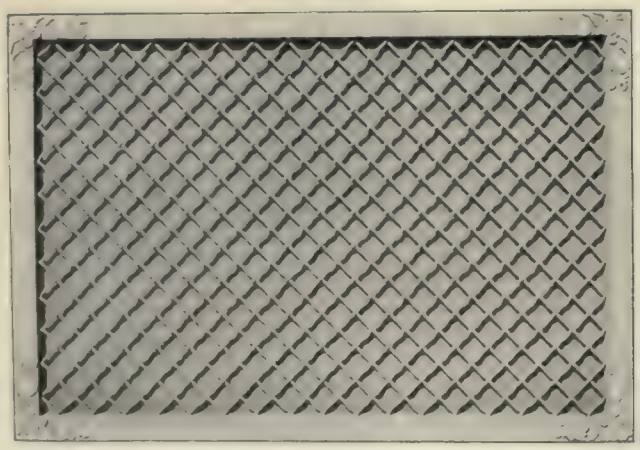

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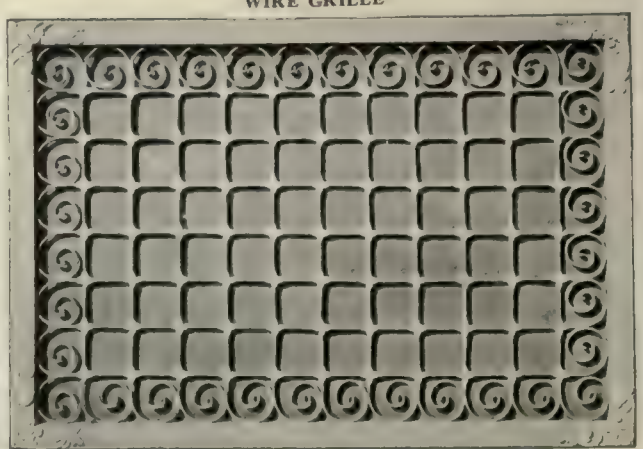

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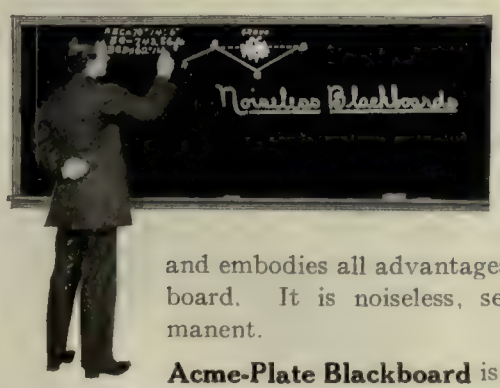

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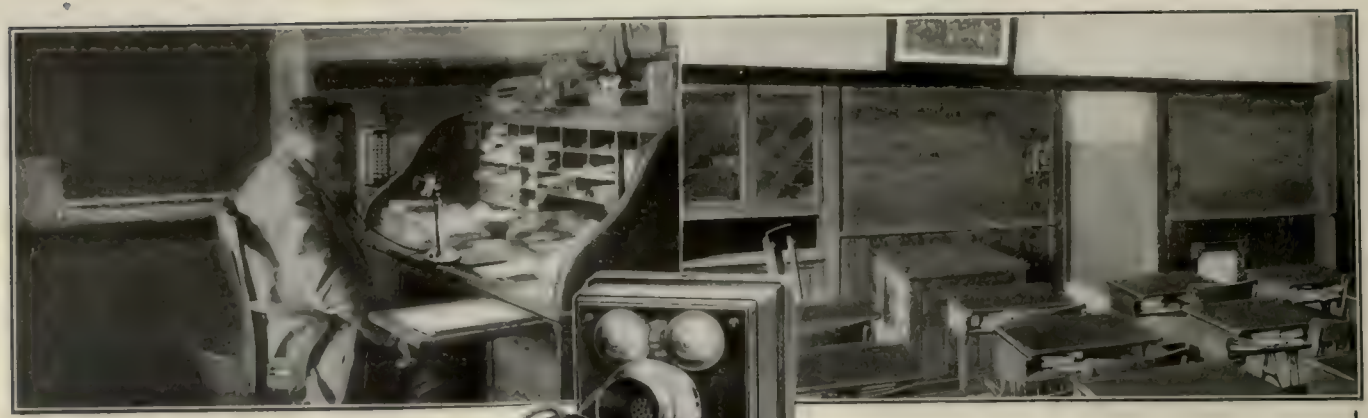

The above illustration shows a No. 2016 metal desk Inter-phone used by the principal of a public school.

A wooden type Inter-phone mounted on the wall of a classroom in a public school.

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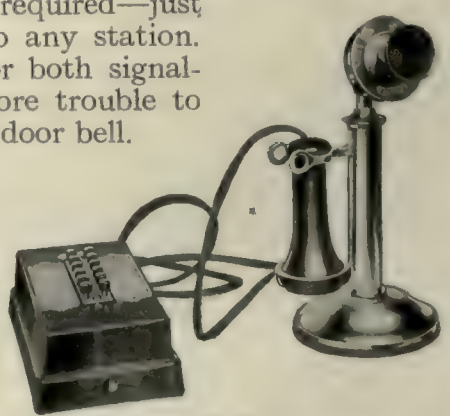

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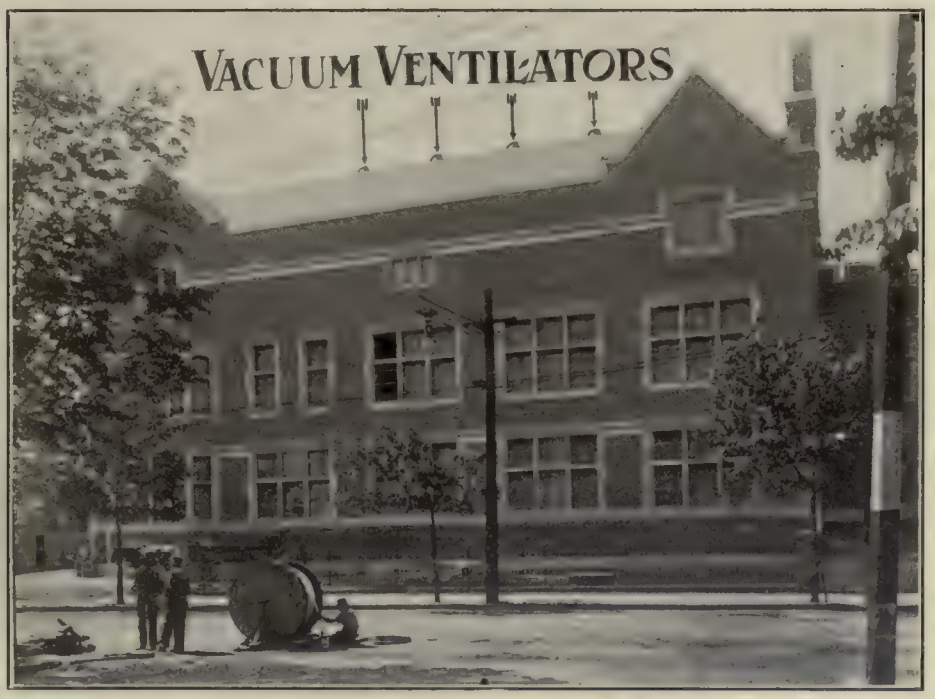

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We shall be glad to have your inquiries and will send you complete descriptive catalogues.

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Over Fifty of Boston's Schools Are Equipped With "COUCH" Telephone Systems

The following schools described in this issue of the American Architect are also equipped with "COUCH" Telephone Systems.

Charlestown High School, Boston, Mass.
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Daniels School, Malden, Mass.
Edward Everett School, Boston, Mass.
Malden High School, Malden, Mass.
Salem High School, Salem, Mass.
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A partial list of other schools equipped with "COUCH" Telephone Systems is given below.

Beverly High School, Beverly, Mass.
Celina High School, Celina, Ohio.
City Point Grammar School, Boston, Mass.
Coddington School, Quincy, Mass.
Eliot School, Boston, Mass.
Eliot-Hancock School, Boston, Mass.
Emerson School, Boston, Mass.
Farragut School, Boston, Mass.
Francis Parkman School, Boston, Mass.
George Putnam School, Boston, Mass.
Harvard Law School, Cambridge, Mass.
Harvard Medical School, Boston, Mass.
Harvard Physical Laboratory, Cambridge, Mass.
High School, Lexington, Mass.
High School, Waltham, Mass.
High School, Reading, Mass.
High School, Newton, Mass.
Lincoln School, Medford, Mass.
Mechanics Arts High School, Boston, Mass.
Mason School, Newton, Mass.
Newtonville Technical High School, Newton, Mass.
Ogden Public School, Toronto, Ont.
Runkle School, Brookline, Mass.
Western State Normal School, Kalamazoo, Mich.

And here is a testimonial of which we are proud:

School Department
Adelbert L. Safford
SUPERINTENDENT
OFFICE HOURS 9 to 6 P.M. on SCHOOL DAYS.
ALSO 7:30 to 9 P.M. on FRIDAYS

Room 13 Old Town Building
Beverly, Massachusetts

Oct. 28, 1909.

S. H. Couch Company,
Boston, Mass.

Gentlemen:-

The telephone service installed by you in our High School Building is satisfactory in every respect. We have a fifty drop board with forty-eight telephones in actual service and the system after two years use has proved ideal. I cannot think of a single improvement in it to be desired.

Yours truly,

Adelbert L. Safford

S. H. COUCH CO. Inc.
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One Hand Upon the Knob Controls the Transom

To open or close transom to any required angle, simply turn the knob on the door trim, and when the required angle is reached, let go, and the transom stops, and cannot be moved until the knob is again turned. No locks, catches or hinges are required to hold the transom, the device itself serving every function required.

No Marring of the Door Trim

All parts of the "RICHMOND" Concealed Transom Lift, except only the operating knob, are concealed within the door trim—the device being installed upon the back of the door jamb before the trim is applied.

The "RICHMOND" Concealed Transom Lift will operate such sized transoms as are used above doorways in hotels, office buildings, apartments, schools, etc. A Giant Pattern Device is made for transoms over entrance doors or casement windows.

"Simply turn the Knob"

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Manufacturers of "RICHMOND" Heating Systems. "RICHMOND" Bath Tubs, Lavatories and Sanitary Plumbing Devices. "RICHMOND" Concealed Transom Lifts. "RICHMOND" Suds Makers. "RICHMOND" Suction Cleaners. "RICHMOND" Vacuum Cleaning Systems.

Five Plants: One at Norwich, Conn.; Two at Uniontown, Pa.; One at Racine, Wis.; One at Chicago, Ill.

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High School Building, Madison, Wisconsin. (Cass Gilbert, Architect.)
Equipped with "RICHMOND" Two-Sweeper Vacuum Cleaning Outfit.

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Madison Public Schools

Madison, Wis. March 18, 1910.

The McCrum-Howell Co.,

Park Ave. and 41st St., New York City.

Gentlemen:-

Your letter of March 16th has just come to hand. Replying I will say that we have used the American Air Cleaning Company's vacuum system for about two years in our new high school building. We have what is called a Four-sweeper plant, but find it necessary to use only two sweepers at the same time inasmuch as two men are able to get over the whole building each day. Our high school building is equivalent to something more than a fifty room elementary grade building. To thoroughly clean this building by the old method with brushes would require about five men daily. With the sweeper two men do the work and do it much more effectively.

The work of our plant is satisfactory in all respects. Our work is done much more thoroughly than it possibly could be done with the old method of sweeping. Our experience leads us to feel that this is the only way to clean a building. It has many advantages both from a sanitary standpoint and from the standpoint of economy.

Trusting that I have given you a fair statement of the work of this sweeper, I remain

Very sincerely yours,

R. J. Judgeon.

The manufacture and sale of all systems of Stationary Vacuum Cleaning formerly made and sold by the American Air Cleaning Co. of Milwaukee, Wis., The Vacuum Cleaning Co. of New York, and The Sanitary Devices Mfg. Co. of Chicago, Ill., are now conducted by The McCrum-Howell Co., of New York and Chicago, under the name of "RICHMOND" Vacuum Cleaning Systems.

Vacuum Cleaning in Schools

Architects who have specialized on modern school building are more or less familiar with the unpleasant experiences connected with the selection of proper ventilating systems designed for properly changing the air in school rooms.

Those who are informed know how easy it is to make claims of ventilation efficiency and how very difficult it has been to find a ventilating system that really ventilates.

School architects who have had experience with vacuum cleaning systems are already well aware of the fact that many manufacturers of vacuum cleaning apparatus claim efficiency for their products and that most of them claim to have evolved systems designed especially for cleaning school rooms.

As a matter of fact but one manufacturer of vacuum cleaning systems has ever taken the pains to develop a vacuum cleaning system by means of which school rooms can be cleaned quickly, thoroughly and in a strictly sanitary manner.

The Company referred to—The American Air Cleaning Co., Milwaukee, Wisconsin—spent many months in interviewing school authorities, including principals of schools, superintendents of schools, janitors, school engineers and others who were familiar with the requirements and the obstacles in the way of thorough school cleaning.

The Company put expert mechanical engineers on the work and tested out every conceivable scheme that seemed to promise good results. It spent money like water in its conscientious effort to develop a perfect system.

As a final result, a system was developed which has been pronounced by those who have seen it in operation as the most perfect school cleaning system that has ever been offered to school authorities.

By means of special tools and appliances, sweeping is done so quickly as to require the surprisingly short average of between six and ten minutes per school room.

All the dust in each room is thoroughly suppressed and instantly removed to an air-tight receptacle in the basement.

The foul air that accompanies the dust and dirt, after it parts with its load of filth, is dis-

(*Continued next page*).

charged into the smoke-stack or chimney flue, or to other free opening to the outside air.

Absolutely no dust whatever is raised in the sweeping process—no particle escapes the tool as it passes over the surfaces being cleaned.

No after-dusting is required, and very little scrubbing is necessary.

From 60 to 70 cubic feet of the stale air found in the rooms is removed each minute. The atmosphere in a vacuum cleaned school building is made sweet, clean and wholesome.

With the dust all expelled and destroyed every day, there is none to soil the hands, clothing and books—and none to inhale.

Calisthenics may be carried on vigorously and as long as desired without raising the least dust, which all teachers of physical culture will appreciate.

This Company has purchased and taken over among others the entire business of the American Air Cleaning Co. above referred to, the Vacuum Cleaner Co. of New York and the Sanitary Devices Manufacturing Co. of Chicago and New York, and it now owns and controls 85 patents covering the manufacture of stationary vacuum cleaning systems.

By combining all the vital features of each of the most capable inventors in this new field of sanitary science, this Company is now able to produce perfect stationary vacuum cleaning systems.

The business hereafter will be done through the plumbing, heating and electrical trades, and all its products will be known under the trade name of "RICHMOND"

All vacuum cleaning systems are sent out under the Company's guarantee.

Our engineering department is at all times at the disposal of architects who desire information relating to the general subject of vacuum cleaning, or to our special systems in particular. Architects are urged to communicate with us at all times on any points relating to sanitary vacuum cleaning.

THE McCRUM-HOWELL CO.

GENERAL OFFICES:

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MANUFACTURERS OF

"RICHMOND" Heating Systems—"RICHMOND" Bath Tubs, Lavatories and Sanitary Plumbing Devices—"RICHMOND" Concealed Transom Lifts—"RICHMOND" Suds Makers—"RICHMOND" Suction Cleaners—"RICHMOND" Vacuum Cleaning Systems

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5-S

St. John's Military Academy, Delafield, Wis.
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THE ST. JOHNS MILITARY ACADEMY

E. E. SMYTHE, SECRETARY.

39 MITCHELL BLDG.

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The McCrum-Howell Co.,

Park Ave., & 41st St., New York City.

Gentlemen:-

Replying to your inquiry of the 16th inst., will say, that about four years ago we installed the American Air Cleaning Company's vacuum system in our Military Academy and it has given the best of satisfaction at all times. We have what is known as the steam-ejector system, the cost of operation being very nominal and maintenance expense practically nothing.

Not only is this apparatus an economic factor in preserving the furnishings of the dormitories, etc., but since its installation, there has been a marked decrease of names on the sick roll, due to the fact as we believe, that the dust is so thoroughly eliminated from our buildings by the Vacuum System.

In the light of our experience as stated, it is a pleasure to recommend the system of the American Air Cleaning Company, to any possible purchaser

Yours very truly,

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